

FLORISTIC COMPOSITION AND BIOLOGICAL SPECTRUM OF RAIPUR FOREST RANGE, DEHRADUN, UTTARAKHAND

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ABSTRACT

A study was carried out in Raipur Forest, Dehradun Garhwal Himalaya, with the primary objective of analysing plant diversity, lifeform, and biological spectrum. The research was conducted from April 2022 to Aug 2023, and several attempts were made to collect plant species at the study site. A total of 116 plant species were recorded, belonging to dicotyledonous (44 families, 92 genera, with 102 species), monocotyledonous (3 families, 10 genera with 10 species), Gymnosperm (1), and Pteridophytes (2). The most dominant habitat was herbs (50 species), followed by shrubs (37 species), trees (21 species), and climbers (8 species). The most dominant family was Asteraceae, followed by Poaceae. Plant species were categorised according to Raunkiaer's system of biological spectrum. Floristic analysis showed that Phanerophytes (53.00 %) were the predominant life form, followed by therophytes (42.00 %), hemicryptophytes (9.00 %), Chamaephyte (9.00%) and geophytes (3.00 %). A relatively high percentage of therophytes indicates that they spend unfavourable periods in the form of seeds. Therophytes (mostly annuals) are drought evaders in the sense that the whole plant is shed during unfavourable conditions. The higher percentage of therophytes at the studied site is due to biotic disturbances. This data will be invaluable in understanding the complex dynamic of vegetation in the Himalayan ecosystem. It will also serve as a vital reference for workers in the field and could play a crucial role in development of conservation strategies in the area.

(Key words: Biological spectrum, floristic composition, life form, Raipur)

INTRODUCTION

India is a country with an incredibly diverse range of flora and fauna. It is home to almost 47,000 species of plants and 90,000 species of animals across ten different biogeographic regions. This makes India one of the 17 countries with mega biodiversity in the world. In terms of plant diversity, India ranks 10th globally and 4th in Asia. The country can be divided into eight distinct floristic regions, including the Western Himalayas, Eastern Himalayas, Assam, Indus Plain, Ganga Plain, Decan, Malabar, and Andaman. (Chatterjee, 2020). The Western Himalayas region, which spans from Kashmir to Kumaon, is particularly rich in a variety of trees such as Chir, pine, deodar, blue pine, spruce, silver fir, and other broad-leaved temperate trees. This region covers three states of India, namely Jammu and Kashmir, Himachal Pradesh, and Uttarakhand, which exhibit great variation in topography and climate. The Indian Himalayan region (IHR) alone houses around 8,000 species of angiosperms (40% endemic), 44 gymnosperms (15% endemic), and 600 pteridophytes (25%) (Bhatt *et al.*, 2016).

The pattern of floristic diversity affects the regional development and its surroundings; therefore, it is

mandatory to understand how the floristic vegetation is classified. Raunkiaer (1934) classified floristic vegetation by using the location of perennating buds or organs into five major groups which are Chamaephytes, Therophytes, Phanerophytes, Hemicryptophytes and Cryptophytes. This spectrum for the phanerogamic flora of the whole world is widely used for comparing biological spectra of different regions. Plant diversity structure, composition and functions are the most significant ecological attributes of a particular ecosystem, which has been threatened by anthropogenic variables (Sharma *et al.*, 2014). The biological spectrums of Indian Himalayan region have been determined by various workers Acharya *et al.* (2011), Shahid and Joshi (2018), Das *et al.* (2020) and Verma *et al.* (2022).

A system can be considered sustainable if it helps to improve or maintain the quality of soil, water, plants, and atmosphere (Yadav *et al.*, 2018). In India, a large proportion of the population live in rural areas and rely on natural resources for their livelihood. Therefore, it is essential to promote domestication and diversification to generate income and reduce the overuse of natural resources in rural regions (Mehta *et al.*, 2022). Raipur Range perpetuates suitable climatic conditions for the luxuriant growth of both

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tropical and temperate species. The Raipur range represents a transitional zone between the upper Gangetic plains and the outer Himalayan region. Climate plays a crucial role in shaping and maintaining floristic diversity, as it directly influences the distribution, growth, and survival of plants. The floristic diversity is valuable for many ecological studies such as succession and nature of plant communities which represents the true image of a terrain and variation of temperature and precipitation provide basic information about regional development.

The study examined floristic composition, life form and biological spectrum in Raipur forest range, Uttarakhand, with the aim to understand vegetation distribution and conservation policies for mountain ecosystems with similar phytoclimatic conditions.

MATERIALS AND METHODS

Study site

The Raipur range is located at 30.306°N, 78.0698°E with an average elevation of 600 m to 1900 m above sea level (msl). The Raipur range is situated in the southwestern part of Dehradun bordered by Shivalik Hills on the south and Song River on the east. It is located 8 km east of Dehradun and in the northwestern part of India. The total area of the Raipur forest range is 9624.10 ha. Functionally Raipur range is divided into 10 forest blocks viz., Kund, Dwara, Bhopalpani, Malsi, Mahipur, Rajpur, Raipur, Ringalgardh, Ladpur and Shripur and has 86 compartments. It lies in a sub-tropical forest zone with an annual rainfall of 2150 mm. (Verma *et al.*, 2013).

Frequent surveys were conducted to obtain a better understanding of the study area and field data were collected during various expeditions from April 2022 to Aug 2023. Several attempts were made to collect plant species in different places under the Raipur range for observation in different seasons. We covered 10% area of the studied site. Plant specimens in the flowering and fruiting stages were collected in the usual method of collection, preservation, and maintenance of specimens in the herbarium as per Jain and Rao (1997) procedure. The whole information regarding the plant species collected was recorded including vernacular name, habit, habitat, and colour of flowers, flowering and fruiting time of each taxon and the altitudes in which they occur. Field data about each specimen of plant material was meticulously recorded during field studies. The plant specimens (herbs, shrubs and trees) collected during field trips were identified with the help of regional floras and confirmed after matching these specimens with authentically identified specimens preserved in the Herbarium of Forest Research Institute (DD) and Botanical Survey of India, Northern Regional Centre (BSD), Dehra Dun. After identification, all the specimens were preserved and mounted on an herbarium sheet and deposited in the Herbarium of Ecological Research Laboratory, Botany Department, D.A.V. (P.G.) College, Dehra Dun.

Data analysis

The growth habits of plants such as trees, shrubs, herbs, and climbers were categorized by their structure, while their life form was categorized based on the position of their vegetative bud above the ground level. Trees were further classified based on their height, with species taller than 30 m being called mega phanerophytes, those between 8-30 m called macrophanerophytes, those between 2-8 m called microphanerophytes, and those less than 2 m but more than 0.25 m called nanophanerophytes. Ground shrubs and perennial herbs were considered chamaephytes, while annual plants were categorised as therophytes. Plant species that bear rhizomes, tubers, and bulbs (perennating buds buried in the ground with aerial parts dying back in winter) were classified as hemicyptophytes (Raunkiaer, 1934).

RESULTS AND DISCUSSION

Plant diversity

In the present study, a total of 116 plant species were recorded belonging to dicotyledonous (44 families, 92 genera, with 102 species), monocotyledonous (3 families, 10 genera with 10 species), Gymnosperm (1) and Pteridophytes (2) were recorded from Raipur range, Dehradun. Description of plants with their families, growth form, life form, perennation of organ, elevation, nativity, longevity along with their period of flowering and fruiting are depicted in Table 1.

On the consideration of habit groups, dominancy was revealed by herbs (50 species) followed by shrubs (37 species), trees (21 species) and climbers (8 species). The high percentage of herbs and shrubs may be due to the existing quality of soil and prevailing climatic factors like temperature and rainfall (Savina *et al.*, 2018). The most dominant family of the study site as per the number of genera and species was Asteraceae with 14 species belonging to 13 genera. The co-dominant families were Poaceae with 8 species and 8 genera, Lamiaceae with 7 genera and 7 species and Acanthaceae with 6 genera and 7 species. Poaceae and Acanthaceae families are also reported to be dominant in other Himalayan regions (Bano *et al.*, 2018, Haqet *al.*, 2019). The study revealed that only two species *Equisetum arvense* and *Thelypteris dentata* showed spore perennation. As per the longevity of the plants, 56 % of the plant species were annuals 40% were perennials and 4% were biennial.

Biological spectrum

According to Raunkiaer (1934), the climate of a region is characterized by life forms, while in biological spectrum of the region exceeds the percentage of the same life form. However, due to biological disturbance, the proportion of life forms may be altered. The biological spectrum may be materially changed due to the introduction of therophytes like annual weeds, due to biotic influences like agricultural practices, grazing, deforestation, trampling etc.

Table 1. Habit classification and life forms of plants observed at Raipur forest range

Sr. No.	Botanical Name	Family	GRF	LF	P. O	FL.P	FR. P.	Elevation	Nativity	Longevity
1.	<i>Abrus precatoris</i>	Fabaceae	Cl	Ph	seed	Oct to April	April to May	637.4±8m	Introduced	Pr
2.	<i>Aegle marmelose</i>	Rutaceae	T	Ph	seed	Jan to May	Feb to July	604.25±8m	Native	Pr
3.	<i>Ageratum conyzoides</i>	Asteraceae	H	Th	seed	Dec to May	Oct to April	708.38±15m	Invasive	An
4.	<i>Alternanthera sessilis</i>	Amaranthaceae	H	Th	seed	Dec to Mar	Nov to April	884.5±24m	Native	An
5.	<i>Amaranthus viridis</i>	Amaranthaceae	H	Th	seed	June to Aug	Aug to Oct	743.12±16m	Introduced	An
6.	<i>Apluda mutica</i>	Poaceae	H	Th	seed	Aug to Nov	Aug to Nov	723.67±8m	Native	An
7.	<i>Argemone mexicana</i>	Papaveraceae	H	Th	seed	May to Nov	July to Jan	1042.75±27m	Introduced	An
8.	<i>Artemisia annua</i>	Asteraceae	H	Th	seed	Aug to Sep	Sep to Oct	690.76±7m	Native	Pr
9.	<i>Asparagus adscendens</i>	Asparagaceae	S	Th	seed	Oct to Nov	Nov to Mar	625.83±9m	Native	Pr
10.	<i>Barleria cristata</i>	Acanthaceae	S	Th	seed	July to Dec	Sep to May	718.5±4m	Native	Pr
11.	<i>Berberis aristata</i>	Berberidaceae	S	Ph	seed	Mar to April	May to June	926.12±13m	Native	An
12.	<i>Berberis koenigii</i>	Rutaceae	S	Ph	seed	Feb to April	July to Aug	743.09±27m	Native	Pr
13.	<i>Bidens biternata</i>	Asteraceae	H	Th	seed	April to Oct	April to Oct	1105.7±7m	Native	An
14.	<i>Blumea lacera</i>	Asteraceae	H	Th	seed	April to May	Oct to April	1064.96±9m	Native	An
15.	<i>Blumea sinuata</i>	Asteraceae	H	Th	seed	Dec to May	Dec to May	1042.72±7m	Native	An
16.	<i>Blumea stricta</i>	Asteraceae	H	Th	seed	Mar to Nov	Mar to Nov	942.31±12m	Native	An
17.	<i>Boerhavia diffusa</i>	Nyctaginaceae	H	Th	seed	Jan to April	Sep to Dec	601.56±9m	Native	An
18.	<i>Bothriochloa insculpta</i>	Poaceae	H	Th	seed	Oct to June	Aug to Dec	708.36±26m	Native	An
19.	<i>Brassica rapa</i>	Brassicaceae	H	Th	seed	May to Aug	July to Sep	946.28±17m	Introduced	An
20.	<i>Broussonetia papyrifera</i>	Moraceae	T	Ph	seed	April to May	Aug to Sep	1082.11±11m	Native	An
21.	<i>Brugmansia suaveolens</i>	Solanaceae	S	Ph	Seed	July to Nov	July to Nov	777.85±10m	Introduced	An
22.	<i>Butea monosperma</i>	Fabaceae	T	Ph	seed	Feb to April	Mar to Dec	749.29±62m	Native	Pr
23.	<i>Calyptocarpus vialis</i>	Asteraceae	H	Th	seed	April to Nov	July to Oct	1052.34±10m	Introduced	Pr
24.	<i>Capparis spinosa</i>	Capparaceae	Cl	Ph	seed	Mar to Sep	Mar to Sep	641.83±16m	Native	Pr
25.	<i>Capsella bursa-pastoris</i>	Brassicaceae	H	Th	seed	May to July	May to July	575.11±6m	Native	An
26.	<i>Cardamine pratensis</i>	Brassicaceae	H	Ph	seed	April to June	June to July	721.92±30m	Native	Pr
27.	<i>Carissa spinarum</i>	Apocynaceae	S	Ph	seed	Feb to April	Mar to Sep	635.18±97m	Native	Pr
28.	<i>Cestrum parqui</i>	Solanaceae	S	Ch	seed	Oct to June	Sep to Oct	615.22±7m	Introduced	Pr
29.	<i>Chenopodium album</i>	Amaranthaceae	H	Th	seed	Feb to Mar	Feb to Mar	991.11±15m	Native	An
30.	<i>Chrysopogon zizanioides</i>	Poaceae	H	He	seed	July to Oct	July to Oct	704.22±4m	Introduced	Pr
31.	<i>Cissampelos pareira</i>	Menispermaceae	Cl	Ch	seed	Aug to Sep	Sep to Oct	944.61±16m	Native	An/Bi
32.	<i>Clematis gouriana</i>	Ranunculaceae	Cl	Ph	seed	Nov to Mar	Mar to Oct	874.81±11m	Native	Pr
33.	<i>Clerodendrum infortunatum</i>	Lamiaceae	S	Th	seed	Mar to April	May to June	744.53±34m	Native	An
34.	<i>Colebrookea oppositifolia</i>	Lamiaceae	S	Ph	seed	Dec to April	Dec to April	704.59±42m	Native	Pr
35.	<i>Coleus barbatus</i>	Lamiaceae	H	Ph	seed	Aug to Oct	Mar to June	1098.71±16m	Native	An
36.	<i>Cynodon dactylon</i>	Poaceae	H	He	seed	Mar to Sep	Mar to Sep	798.4±12m	Native	An
37.	<i>Debregeasia longifolia</i>	Urticaceae	S	Ph	seed	Aug to Dec	Sep to Feb	836.36±27m	Invasive	Pr

38.	<i>Dicliptera bupleuroides</i>	Acanthaceae	H	Ph	seed	Nov to June	Dec to June	675.97±12m	Native	An
39.	<i>Dioscorea bulbifera</i>	Dioscoreaceae	Cl	Th	seed	Sep to Nov	Sep to Nov	743.2±11m	Native	An
40.	<i>Duhaldea cappa</i>	Asteraceae	S	Th	seed	Aug to Feb	Aug to Feb	1072.62±12m	Native	An
41.	<i>Dunalia spinosa</i>	Solanaceae	H	Th	seed	Mar to April	Mar to April	770.11±9m	Introduced	An
42.	<i>Ehretia acuminata</i>	Boraginaceae	T	Ph	seed	Sep to Nov	Jan to April	704.61±27m	Native	Pr
43.	<i>Ehretia aspera</i>	Boraginaceae	T	Ph	seed	Feb to Mar	Mar to June	744.58±36m	Native	Pr
44.	<i>Equisetum arvense</i>	Equisetaceae	H	Ph	Spores	Mar to April	June to Aug	1091.73±8m	Native	Pr
45.	<i>Erigeron canadensis</i>	Asteraceae	H	Th	seed	July to Dec	Sep to Dec	836.37±29m	Introduced	An
46.	<i>Ficus benghalensis</i>	Moraceae	T	Ph	Seed	Nov to Jan	Nov to Jan	861.31±3m	Native	Pr
47.	<i>Ficus racemosa</i>	Moraceae	T	Ph	seed	Feb to May	Feb to May	798.4±27m	Native	Pr
48.	<i>Ficus virens</i>	Moraceae	T	Ph	seed	Feb to May	June to Sep	1099.34±11m	Native	Pr
49.	<i>Flemingia paniculata</i>	Fabaceae	S	Ph	seed	Jan to April	Feb to Mar	689.8±36m	Native	Pr
50.	<i>Flemingia strobilifera</i>	Fabaceae	H	Ph	seed	Oct to Dec	Nov to Feb	714.6±4m	Native	Pr
51.	<i>Foeniculum vulgare</i>	Apiaceae	H	Ph	seed	June to Aug	Sep to Oct	704.62±31m	Native	Pr
52.	<i>Geranium ocellatum</i>	Geraniaceae	H	He	seed	Mar to April	Mar to April	836.4±27m	Native	An
53.	<i>Grona triflora</i>	Fabaceae	H	Ph	seed	July to Dec	July to Dec	1080.22±11m	Native	An
54.	<i>Himalrandia tetrasperma</i>	Rubiaceae	S	He	seed	April to May	May to June	904.25±19m	Native	Pr
55.	<i>Hordeum vulgare</i>	Poaceae	H	Th	Seed	June to Aug	June to Aug	1010.37±27m	Introduced	An
56.	<i>Ipomoea carnea</i>	Convolvulaceae	S	Ph	seed	Mar to Nov	Mar to Nov	653.67±9m	Introduced	An
57.	<i>Jurinea heteromalla</i>	Asteraceae	H	Th	Seed	Mar to Aug	Mar to April	691.36±8m	Native	Bn
58.	<i>Justicia adhatoda</i>	Acanthaceae	S	Th	seed	Feb to April	Mar to Sep	903.02±19m	Native	An
59.	<i>Lantana camara</i>	Verbenaceae	S	Ph	seed	May to Oct	May to Oct	700.6±32m	Introduced	Pr
60.	<i>Lepidagathis cuspidata</i>	Acanthaceae	S	He	seed	Dec to Jan	Oct to Mar	704.65±25m	Native	An
61.	<i>Lepidagathis scariosa</i>	Acanthaceae	S	Ch	seed	Nov to Feb	Nov to Feb	1073.99±16m	Native	Pr
62.	<i>Leucas biflora</i>	Lamiaceae	H	Th	seed	Oct to Feb	Oct to Feb	651.21±20m	Native	Pr
63.	<i>Leucomeris spectabilis</i>	Asteraceae	S	Ph	seed	April to June	April to June	627.42±14m	Native	An/Bi
64.	<i>Madhuca longifolia</i>	Sapotaceae	T	Ph	seed	Feb to April	May to June	1091.73±8m	Native	Pr
65.	<i>Mallotus philippensis</i>	Euphorbiaceae	T	Ph	seed	Mar to April	May to July	613.59±6m	Native	Pr
66.	<i>Malvastrum coromandelianum</i>	Malvaceae	H	Th	seed	Oct to April	Sep to Nov	1048.36±10m	Introduced	An
67.	<i>Melia azedarach</i>	Meliaceae	T	Ph	seed	May to Dec	May to Dec	769.85±28m	Native	Pr
68.	<i>Mimosa pudica</i>	Fabaceae	H	Ch	seed	Nov to Mar	July to Jan	1025.14±6m	Introduced	Pr
69.	<i>Mimosa rubicaulis</i>	Mimosaceae	S	He	seed	June to Aug	Sep to Nov	629.52±37m	Native	Pr
70.	<i>Nasturtium officinale</i>	Brassicaceae	H	Ch	Seed	April to June	April to June	704.59±59m	Native	An
71.	<i>Oenothera rosea</i>	Onagraceae	H	Cr	seed	April to Aug	May to Nov	674.41±12m	Introduced	Pr
72.	<i>Oreosheris gossypina</i>	Asteraceae	H	Th	seed	Mar to June	Mar to June	754.41±13m	Native	Pr
73.	<i>Ourea san guinolenta</i>	Amaranthaceae	S	Ph	seed	Sep to Jan	Sep to Jan	1057.94±19m	Native	Pr
74.	<i>Oxalis corniculata</i>	Oxalidaceae	H	He	Seed	Mar to Oct	Mar to Oct	997.56±12m	Native	An
75.	<i>Parthenium hysterophorus</i>	Asteraceae	H	Th	seed	Oct to Mar	Oct to Mar	778.1±11m	Introduced	An
76.	<i>Phlogacanthus thyrsoformis</i>	Acanthaceae	S	Ph	seed	Feb to Mar	Feb to Mar	629.53±27m	Native	Pr
77.	<i>Phoenix canariensis</i>	Arecaceae	T	Ph	seed	Oct to Mar	Oct to Mar	775.06±44m	Introduced	Pr
78.	<i>Pinus roxburghii</i>	pinaceae	T	ph	seed	Mar to April	April to May	817.19±28m	Native	Pr

79.	<i>Pistacia khinjuk</i>	Anacardiaceae	T	Ph	seed	Mar to June	Aug to Sep	1078.18±29m	Native	Pr
80.	<i>Plumbago zeylanica</i>	Plumbaginaceae	S	Th	seed	Dec to Mar	Nov to Mar	675.83±6m	Native	An
81.	<i>Pogostemon benghalensis</i>	Lamiaceae	S	Ph	seed	April to Dec	Jan to Mar	726.81±25m	Native	Pr
82.	<i>Polygonum plebeium</i>	Polygonaceae	H	Cr	seed	Jan to July	Jan to July	827.11±11m	Native	An/Pr
83.	<i>Potentilla indica</i>	Rosaceae	H	He	seed	May to Oct	July to Oct	744.22±17m	Native	Pr
84.	<i>Pseudocaryopteris bicolor</i>	Verbenaceae	S	Ch	seed	Feb to July	Feb to July	1059.69±22m	Native	Pr
85.	<i>Psidium guajava</i>	Myrtaceae	T	Ph	seed	Feb to Mar	July to Sep	836.37±37m	Introduced	Pr
86.	<i>Pterospermum acerifolium</i>	Malvaceae	T	Ph	seed	July to Aug	Jan to April	836.37±24	Introduced	Pr
87.	<i>Pyrus pashia</i>	Rosaceae	T	Ph	seed	Mar to April	Nov to Dec	993.48±15m	Native	Pr
88.	<i>Ranunculus sceleratus</i>	Ranunculaceae	H	Th	Seed	May to Sep	Feb to May	752.82±14m	Native	An
89.	<i>Reinwardtia indica</i>	Linaceae	S	Ch	seed	Nov to May	Sep to Mar	685.49±10m	Native	Pr
90.	<i>Rubus ellipticus</i>	Rosaceae	S	Ph	seed	Feb to April	Feb to April	1079.14±28m	Native	Pr
91.	<i>Rumex hastatus</i>	Polygonaceae	S	Ph	seed	April to June	June to Oct	1133.48±7m	Native	Bn
92.	<i>Rungia pectinata</i>	Acanthaceae	H	He	seed	Nov to April	Mar to April	702.57±36m	Native	An
93.	<i>Scrophularia nodosa</i>	Scrophulariaceae	H	Th	Seed	June to Sep	July to Sep	938.15±13m	Introduced	Pr
94.	<i>Setaria verticillata</i>	Poaceae	H	Th	Seed	July to Oct	July to Sep	793.7±28m	Native	An
95.	<i>Shorea robusta</i>	Dipterocarpaceae	T	Ph	seed	April to May	May to July	787.45±37m	Native	Pr
96.	<i>Sida acuta</i>	Malvaceae	S	Ph	seed	Sep to May	Sep to May	704.61±28m	Introduced	An
97.	<i>Sida rhombifolia</i>	Malvaceae	S	Ph	seed	July to Dec	July to Jan	628.91±11m	Introduced	An
98.	<i>Smilax rotundifolia</i>	Smilacaceae	Cl	Ph	seed	April to Aug	Aug to Sep	610.42±7m	Introduced	Pr
99.	<i>Solanum asperolanatum</i>	Solanaceae	S	Ph	seed	Feb to April	Aug to Nov	1057.28±12m	Introduced	Pr
100.	<i>Solanum erianthum</i>	Solanaceae	S	Ch	Seed	Feb to Nov	Feb to Nov	715.26±19m	Introduced	Pr
101.	<i>Solanum nigrum</i>	Solanaceae	H	Th	seed	April to June	July to Aug	1075.18±18m	Native	An
102.	<i>Solanum viarum</i>	Solanaceae	S	Th	seed	May to July	Aug to Nov	817.04±10m	Introduced	An
103.	<i>Syzygium cumini</i>	Myrtaceae	T	Ph	seed	Mar to April	May to July	783.3±27m	Introduced	Pr
104.	<i>Tectona grandis</i>	Lamiaceae	T	Ph	seed	June to Aug	Sep to Dec	541.17±36m	Introduced	Pr
105.	<i>Terminalia bellirica</i>	Combretaceae	T	ph	seed	Mar to April	April to May	605.85±15m	Introduced	Pr
106.	<i>Thelypteris dentata</i>	Aspleniaceae	H	Th	Spores	May to Nov	May to Nov	609.14±8m	Native	Pr
107.	<i>Thysanolaena latifolia</i>	Poaceae	H	Th	seed	Mar to June	Mar to June	785.67±8m	Native	An
108.	<i>Ticanto crista</i>	Fabaceae	Cl	Ph	Seed	Mar to June	June to Nov	598.76±14m	Native	Pr
109.	<i>Toona ciliata</i>	Meliaceae	T	Ph	seed	Nov to Dec	Nov to Dec	944.51±13m	Native	Pr
110.	<i>Tridax procumbens</i>	Asteraceae	H	Th	seed	June to Oct	June to Oct	612.06±7m	Introduced	An
111.	<i>Tripidium rufipilum</i>	Poaceae	H	Th	seed	July to Sep	July to Sep	585.08±11m	Native	An
112.	<i>Vallaris solanacea</i>	Apocynaceae	Cl	Th	seed	Dec to April	Dec to April	621.41±31m	Native	Pr
113.	<i>Verbascum thapsus</i>	Scrophulariaceae	H	Cr	seed	June to Aug	Sep to Oct	1055.14±13m	Native	Bn
114.	<i>Vitex negundo</i>	Lamiaceae	S	Ph	seed	June to Aug	Sep to Dec	836.37±25m	Native	Pr
115.	<i>Woodfordia fruticosa</i>	Lythraceae	S	Ch	seed	May to June	Feb to April	834.31±30m	Native	Pr
116.	<i>Ziziphus mauritiana</i>	Rhamnaceae	S	Th	seed	Sep to Nov	Dec to Feb	948.72±13m	Native	Pr

Note- GRF = Growth form; L.F = Lifeform; P.O = Perennation of an organ; Fl. P = Flowering period; FR.P = Fruiting period; T = Tree; S = Shrub; H = Herb;

Cl = Climber; Ph = Phanerophytes; Th = Therophytes; He = Hemicryptophytes; Ch = Chamaephyte; Ge = Geophytes; An = Annual; Bi = Biennial and Pr = Perennial

Plant species were categorized according to Raunkiaer's system. Floristic analysis showed that Phanerophytes (53.00 %) were the predominant life form,

followed by therophytes (42.00 %), hemicryptophytes (9.00 %), Chamaephyte (9.00%) and geophytes (3.00 %).

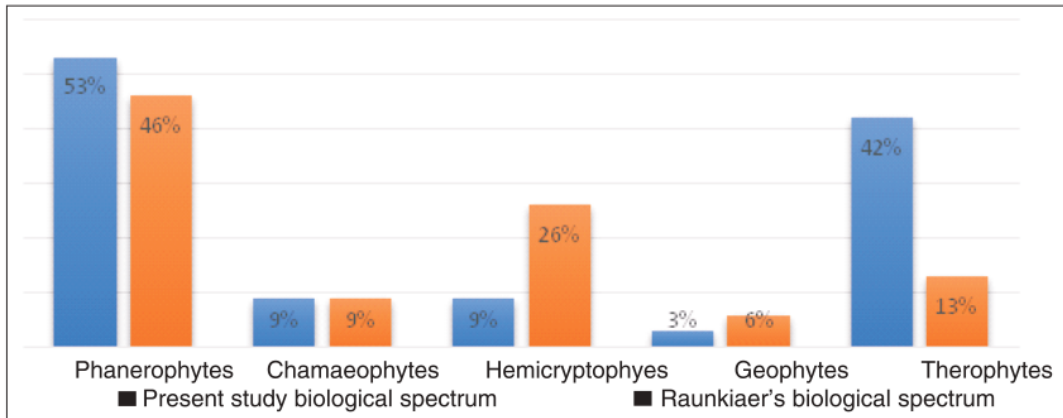


Figure 1. Comparison of life forms of the present study site with Raunkiaer's life form

The Therophytes (42.00%) are more than three times higher than those of the Raunkiaer's biological spectrum (13.00%). Geophytes (3.00%) and Hemicryptophytes (9.00%), were less than two and three times those of the Raunkiaer's biological spectrum (26.00%) and (6.00%) respectively. Phanerophytes (53.00 %) showed a higher percentage than Raunkiaer's biological spectrum (46.00%) and Chamaeophytes (9.00%) represent the same value as Raunkiaer's biological spectrum (9.00 %) (Figure 1).

In the study area, tropical vegetation was characterized by the dominance of Phanerophytes, as noted by Raunkiaer in 1934. This indicates that these plants are well-adapted to the region. Similarly, Verma *et al.* (2022) found phanerophytes were the most dominant life form in their studies. On the other hand, the low percentage of Hemicryptophytes and Geophytes suggests that these plants are not well-suited to the existing climate and soil conditions.

The study area in the Garhwal Himalaya showed a higher percentage of therophytes. These plants are known for their ability to survive in extreme weather conditions in the form of seeds. They are commonly found in hot, cold and dry environments. The reason behind their dominance in this region is due to the biotic interference that includes deforestation, overgrazing, and intensive land utilization for farming. Additionally, their presence is a good indicator of the monosomic climate. On the other hand, phanerophytes are abundant in the area, but their presence is not as significant as that of therophytes. Therefore, the dominance of these life forms suggests their adaptability and survival in adverse climatic conditions.

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