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Full Length Article

The Phytoclimatic Spectrum of Weed Flora of Nomal Valley, District Gilgit, Gilgit-Baltistan, Pakistan

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Abstract

This study aimed to determine the phytoclimatic spectrum, provide taxonomic information, and recognize the dominant taxa of the weed flora in Nomal Valley. To find the phytoclimatic conditions of weed flora, we developed an inventory of the recorded flora. This study documented the baseline inventory of a total of 119 phanerogam species, which comprised of 99 genera belonging to 46 families. For phytosociological studies, the study area was divided into three stands, and in each stand, thirty quadrants were placed to calculate the importance value index (IVI). Along with IVI, this study also explored the breakdown of habit categories and the dominant life form present in the study area. The dominant habit category was herbs, comprised of 78 species (66%), 23 tree species (19%), 14 shrubs species (12%), and 4 sub-shrubs species (3%), respectively. Meanwhile, the dominant life form recorded in the area was therophytes, with 46 species contributing (39%) of the local flora, followed by hemicryptophytes with 43 species (36%), and phanerophytes with 28 species (23%). Chamaephytes and geophytes each represented one species (1%). The results showed the dominant life form was therophyte, indicating that the study area prevailed in hot climatic conditions. Based on the IVI, *Dichanthium annulatum* emerged as the dominant species, boasting the highest IVI value of 61.18, underscoring its significant presence within the agroecosystem. To assess the current and future phytoclimatic conditions in an agroecosystem, such investigations should be conducted in the study area.

Keywords: Agroecosystem; Habit; Life form; Flora; Taxa

Introduction

The phytoclimatic spectrum can be used to identify and explore the requirements for long-term conservation approaches to the natural habitat of species in a region (Khan *et al.* 2013). The flora of any region in the natural habitat depends on environmental factors such as time, altitude, and precipitation patterns (Ilyas and Moncrieff 2012; Majeed *et al.* 2022). Ecologists have been researching the composition of plant species relying on interaction and habitat phytoclimatic variability (Shaheen *et al.* 2012; Majeed *et al.* 2022). The floral composition of the community is influenced by altitude and many other factors (Patel *et al.* 2010; Jahangeer *et al.* 2020). The changing environmental factors associated with elevation in mountains create unique opportunities to study how biodiversity responds within confined geographic areas (Biase *et al.* 2021). The plant species and life forms show the external appearance of how they adapt to the climatic conditions. It is not viable to count the abundance of each single species in the area. To explore the abundance and presence of species in any region by taking a sample with the supposition that it is representative of the region. The sampling techniques comprise desired data, objectives, physical characteristics of vegetation, and time (Jahangeer *et al.* 2020). It is not enough to only evaluate the vegetation in this fragile and sensitive natural community; it is also important to identify the phytoclimatic spectrum of a region. The floral diversity and climate interactions in a region are seen as signs and indicators of the natural community's general vitality (Saqib *et al.* 2011; Jahangeer *et al.* 2020). In sensitive mountainous areas, the variation in height exerts a substantial influence on temperature, particularly in the summer. This rapid decline in temperature patterns and increasing elevation establishes the boundaries of plant distribution and creates different habitats (Shaheen and Shinwari 2012; Sekar *et al.* 2023).

Plant sprouts modify the environment of ecosystems (Haider and Ibrahim 2022). According to the Raunkiaer provided biological gradient (Raunkiaer 1934), to identify the flora types and the vegetation aspect, the climatic condition plays a vital role in each ecosystem and

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community, known as plant morphology and physiognomy. Raunkiaer used different plant life forms to define phytoclimates, a concept already familiar within the scientific community (Biase *et al.* 2021).

The following ideas were established: (1) the floral composition exhibits resilience in the face of severe climatic challenges. (2) A correlation exists between the developmental stage and the life form within the natural community. (3) Optimal plant growth occurs when species demonstrate adaptability to diverse environmental conditions and fluctuations. Understanding the correlation between life forms and environmental conditions is vital. Raunkiaer's principle helps decipher this relationship, guiding effective plant management strategies (Haider and Ibrahim 2022).

This study revealed the first investigation in an unexplored area where no previous research has been conducted. The objective of this study was to identify the phytoclimatic spectrum, taxonomic details, and dominant taxa within the weed flora and to determine the phytoclimatic conditions linked to the weed flora in the study area, thereby improving our comprehension of the environmental factors influencing the presence and characteristics of these weeds. This study conducted a comprehensive and scientifically rigorous assessment of the plant diversity in the area, accompanied by an analysis of the unique biological spectrum present in floral biodiversity.

Materials and Methods

Study area

The study area, Nomal, is a charming valley located 25 km north of Gilgit city in the Gilgit district of northern Pakistan. Connected to Naltar Bala and Naltar Pain through the Naltar Road/Nomal Naltar Express Road, this captivating valley serves as a vital link. Its strategic location makes it a popular starting point for exploring the renowned tourist destination of Naltar, drawing visitors from both national and international spheres. The study area is depicted in Fig. 1.

Field survey and equipment

Field surveys were conducted across various locations within the study area throughout different seasons, spanning from April to September (Khadim and Khan 2021). The equipment employed during these surveys included a cutter, plastic bag, field notebook (Schmidt *et al.* 2005), pencil, gloves, measuring tape, steel nail, string, mobile camera, presser, and drier (Khadim *et al.* 2024).

Data collection and identification

Throughout the field survey, we amassed significant qualitative and quantitative data, encompassing field observations, plant specimens, and elevation measurements to characterize ecological zones. The collected plant specimens were carefully pressed using a presser and dried with a dryer (Abbas *et al.* 2014). Subsequently, these preserved specimens were mounted onto herbarium sheets standardized at 11.5 × 17.5 inches (Yatsenko *et al.* 2021; Khadim *et al.* 2024). Plant identification was conducted utilizing the flora of Pakistan (Ali and Qaiser 1986) as a reference guide.

Phytosociological studies

The phytosociological studies were done through the plant plot sampling method (Quadrat Method). For this study, thirty quadrats were randomly taken from each stand (Onoda *et al.* 2017). Among these, 10 plots were used for tree sampling in each stand, while the remaining 20 plots were used for herb and shrub sampling in each stand. The plot size used for the tree sample was 10 m x 10 m and the quadrates used for herb and shrub samplings were 5 m x 5 m in size. The subsequent formulas were utilized for computing various attributes (Curtis and McIntosh 1950; Karima *et al.* 2024).

$$\text{Absolute density} = \frac{\text{Total number of all individual of a species in all quadrats}}{\text{Total area of the sample plots}}$$

$$\text{Relative density} = \frac{\text{Number of individuals of a species}}{\text{Total area of all individuals os a species}} \times 100$$

$$\text{Absolute frequency} = \frac{\text{Number of quadrats which occur}}{\text{Total points taken}}$$

$$\text{Relative frequency} = \frac{\text{Absulote frequancy of a species}}{\text{Sum of absulte frequancy of all species}} \times 100$$

$$\text{Absoulte cover} = \frac{\text{Total cover of a species}}{\text{Total number of plant of a species}}$$

$$\text{Relative cover} = \frac{\text{Total cover of all plants of a species}}{\text{Total cover of all species}} \times 100$$

$$\text{Importance Value Index (IVI)} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Cover}$$

Simpson's diversity index (SID)

The Simpson's Diversity Index (SID) accounts for both species abundance and their even distribution, thus indicating that greater richness and evenness result in increased diversity (Simpson 1949).

$$\textbf{Simpson's Diversity Index(D)} = 1 - \left(\frac{\sum n(n-1)}{N(N-1)}\right)$$

Where:
Σ: A Greek symbol that means "sum"
D: represents the Simpson Diversity Index.
n: is the number of individuals of a particular species.
N: is the total number of individuals in the sample.

The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity (Nohro and Jayakumar 2020).

Results

The plant diversity

The study area revealed a rich diversity in its floristic composition, with the weed community encompassing 119 species from 99 genera across 46 families, as highlighted in Fig. 2. Table 1 provides a detailed breakdown of the weed

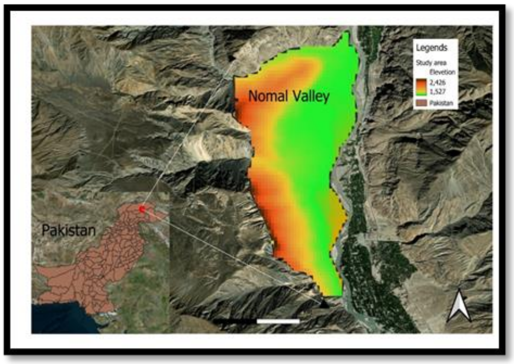

Fig. 1: Cartographic representation of the study area

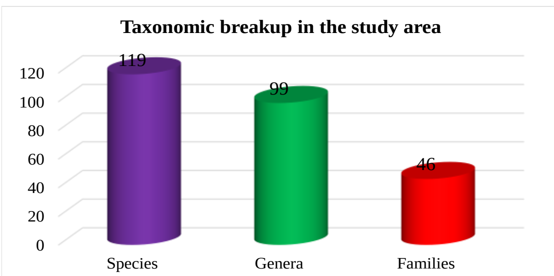

Fig. 2: The taxonomic composition observed in the study area

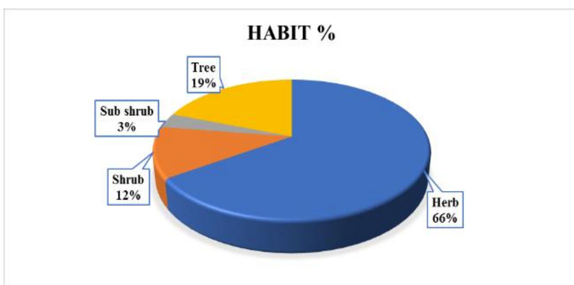

Fig. 3: Distribution of habit categories expressed as percentages in the study area

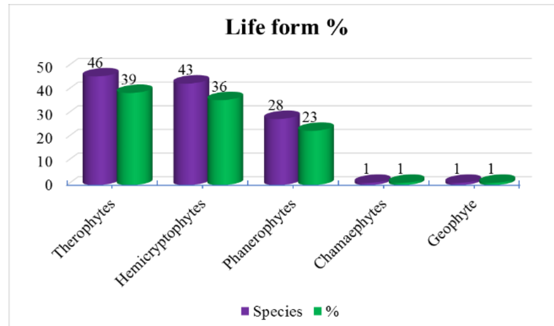

Fig. 4: The percentages of different life forms in the study area

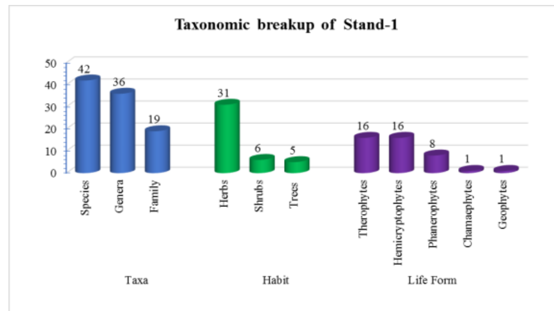

Fig. 5: Taxonomic composition of the stand 1

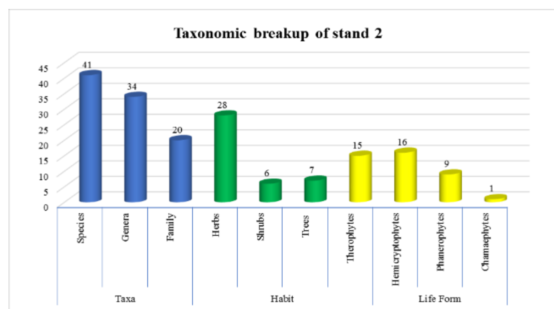

Fig. 6: The taxonomic composition of stand 2

flora inventory within the study area. Herbaceous plants emerged as the dominant habit category, comprising 78 species (66%), followed by 23 tree species (19%), 14 shrubs species (12%), and 4 sub-shrubs species (3%), as illustrated in Fig. 3. The analysis of life form categories revealed a prevalence of therophytes, accounting for 46 species (39%), followed by 43 hemicryptophytes species (36%) and 28 phanerophytes species (23%). Chamaephytes and geophytes each represented single species (1%), as depicted in Fig. 4.

Stand-1

Stand 1 showed a very diverse floral composition, comprised of 42 species belonging to 36 genera across 19 families. The habit category prevailing in the study area was 13 herb species (74%), 6 shrub species (14%) and 5 tree species (12%). The analysis of life forms revealed a balanced distribution, with therophytes and hemicryptophytes each representing 16 species (38%), phanerophytes making up 8 species (20%), chamaephytes and geophytes each comprising single species (2%) depicted in Fig. 5.

Stand-2

Stand 2 displayed a remarkable floral diversity, comprising 41 species from 34 genera spanning 20 families. Herbs dominated the habitat with 28 species (68%), followed by 7 tree species (17%) and 6 shrub species (15%). Upon analysis of life forms, hemicryptophytes emerged as the dominant category, representing 16 species (39%), closely followed by 15 therophytes species (37%), 9 phanerophytes species (22%), and chamaephytes, which accounted for single species (2%) of the species. These findings, crucial for research documentation, are visually depicted in Fig. 6.

Table 1: Inventory of floral diversity within the study site

S. No.	Family name	Species name	Habit	Habitat	Life form*	Altitude	Status	Remarks
1	Apiaceae	*Daucus carota* L.	Herb	Moist	Th	1466 m	Abundant	Wild
2	Apiaceae	*Trachydium roylei* Lidl.	Herb	Moist	He	1476 m	Abundant	Wild
3	Apocynaceae	*Nerium oleander* L.	Shrub	Dry/moist	Th	1384 m	Abundant	Wild
4	Asteraceae	*Artemisia cappillaris* Miq.	Sub-shrub	Moist	He	1980 m	Abundant	Wild
5	Asteraceae	*Artemisia scoparia* Waldst. & Kit.	Herb	Sandy	He	1452 m	Frequent	Wild
6	Asteraceae	*Artemisia sieversiana* Ehrh.ex Willd.	Herb	Moist/stony	He	1262 m	Abundant	Wild
7	Asteraceae	*Artmisia vulgaris* L	Herb	Sandy	He	1416 m	Abundant	Wild
8	Asteraceae	*Brachyist umbrosa*	Herb	Moist	Th	1444 m	Abundant	Wild
9	Asteraceae	*Careopsis lanceolata* L.	Herb	Moist	He	1232 m	Abundant	Wild
10	Asteraceae	*Cirsium argyracanthum* DC.	Sub-shrub	Moist	He	2400 m	Abundant	Wild
11	Asteraceae	*Conyza canadensis* (L.) Cronquist	Herb	Moist	Th	1836 m	Abundant	Wild
12	Asteraceae	*Conyza sumatrensis* (Retz.) E. Walker	Herb	terrestrial	Th	1617 m	Abundant	Wild
13	Asteraceae	*Erigron hetertresus* L.	Herb	Moist	Th	1650 m	Frequent	Wild
14	Asteraceae	*Galinsoga formosa* Canne.	Herb	Moist	Th	1499 m	Abundant	Wild
15	Asteraceae	*Galinsoga parviflora* Cav.	Herb	Sandy	Th	1488 m	Abundant	Wild
16	Asteraceae	*Helianthus annus* L.	Herb	Moist	Th	1478 m	Abundant	Cultivated
17	Asteraceae	*Lactuca serriola* L.	Herb	Dry	Th	1563 m	Abundant	Wild
18	Asteraceae	*Scorzonera virgata* DC.	Herb	Moist	He	1645 m	Abundant	Wild
19	Asteraceae	*Sonchus asper* L.	Herb	Moist	Th	1460 m	Abundant	Wild
20	Asteraceae	*Tagetes erecta* L	Herb	Dry	Th	1355 m	Abundant	Wild
21	Asteraceae	*Tagetes minuta* L	Herb	Moist	Th	1314 m	Abundant	Wild
22	Asteraceae	*Taraxacum officinale* F.H.Wigg.	Herb	Moist	He	1551 m	Abundant	Wild
23	Balsaminaceae	*Impatients balasmina* L	Herb	Humid moist	Th	1864 m	Rare	Wild
24	Berberidaceae	*Berberis orthobotrys vulgaris* L	Shrub	Dry or moist	He	1820 m	Abundant	Wild
25	Boraginaceae	*Heliotropium dasycarpum Ledeb*	Herb	Moist	He	1745 m	Abundant	Wild
26	Brassicaceae	*Capsella bursa patoris* . Medik.	Herb	Moist	Th	1902 m	Abundant	Wild
27	Brassicaceae	*Dascuraina sophia* (L.) Webb ex Prantl	Herb	Sandy	Th	1691 m	Abundant	Wild
28	Brassicaceae	*Rorippa islandica* (Oeder ex Murry Borbas)	Herb	Moist	Th	1499 m	Abundant	Wild
29	Brassicaceae	*Sinapis arvensis* L.	Herb	Dry/moist	Th	1632 m	Frequent	Wild
30	Cannabaceae	*Cannabis sativa* L.	Herb	Moist	Th	1643 m	Rare	Wild
31	Capparidaceae	*Cappris spinosa* Linn.	Shrub	Rocks	He	2106 m	Abundant	Wild
32	Caryophyllaceae	*Cerastium cerastiodes* L	Herb	Stony	He	1712 m	Rare	Wild
33	Chenopodiaceae	*Chenopodium album* L	Herb	Sandy	Th	1845 m	Abundant	Wild
34	Chenopodiaceae	*Kochio scoparia* (L.) Schard.1	Shrub	Dry	Th	1686 m	Abundant	Wild
35	Chenopodiaceae	*Salsola tragus* L	Shrub	Dry	Ph	1430 m	Frequent	Wild
36	Chenopodiaceae	*Suaeda heterophylla* Bunge ex Boiss.	Herb	Sandy	Th	1902 m	Frequent	Wild
37	Cucurbitaceae	*Cucumis milo* L.	Herb	Moist	Th	1526 m	Abundant	Cultivated
38	Cupressaceae	*Thuja Occidentalis* L.	Tree	Moist/dry	Ph	1705 m	Abundant	Wild
39	Cyperaceae	*Cyperus Linneaus*	Herb	Wet	He	1510 m	Abundant	Wild
40	Ebenaceae	*Diospyros kaki* Thunb.	Tree	Moist	Ph	1702 m	Abundant	Cultivated
41	Elaeagnaceae	*Elaegnus angustifolia* L.	Tree	Moist	He	2107 m	Abundant	Cultivated
42	Elaeagnaceae	*Elaegnus umbellata* Thunb.	Shrub	Moist	Ph	1688 m	Rare	Wild
43	Elaeagnaceae	*Hippophae rhamnoid* L.	Shrub	Dry/moist	He	1448 m	Frequent	Wild
44	Ephedraceae	*Ephedra intermedia* L	Shrub	Dry	Ph	1549 m	Abundant	Wild
45	Equisetaceae	*Equisetum fluviatile* L.	Herb	Moist	He	1645 m	Frequent	Wild
46	Fabaceae	*Medicago Sativa* Linn.	Herb	Moist	Th	2107 m	Abundant	Cultivated
47	Fabaceae	*Meliotus alba* Desv.in Lam. Encycl.	Herb	Dry/moist	Th	1412 m	Rare	Wild
48	Fabaceae	*Phaseolus vulgaris* L.	Herb	Moist	Th	1512 m	Abundant	Cultivated
49	Fabaceae	*Rubia pseuda-acacia* L.	Tree	Stony/rocky	Ph	1439 m	Abundant	Wild
50	Fabaceae	*Saphora mollis* Subsp. Griffithii	Shrub	Stony	Ph	1700 m	Abundant	Wild
51	Fabaceae	*Trifoilum pretense* L.	Herb	Moist	He	1828 m	Abundant	Wild
52	Fabaceae	*Trifolium repense* Linneaus.	Herb	Moist	He	1803 m	Abundant	Wild
53	Geraniaceae	*Geranium pratense* L.	Herb	Moist	He	1635 m	Rare	Wild
54	Hypericaceae	*Hypericum calycinum* L.	Sub-shrub	Moist	He	1408 m	Frequent	Cultivated
55	Iridaceae	*Iris lactea* Pall.	Herb	Moist	He	1688 m	Abundant	Wild
56	Juglandaceae	*Juglans regia* L.	Tree	Sandy	Ph	1905 m	Abundant	Cultivated
57	Lamiaceae	*Mentha arvensis* L.	Herb	Moist	He	1633 m	Abundant	Cultivated
58	Lamiaceae	*Mentha longifolia* L.	Herb	Moist	He	1900 m	Abundant	Wild
59	Lamiaceae	*Nepeta cateria* L.	Herb	Dry	He	1383 m	Abundant	Wild
60	Lamiaceae	*Prunella vulgaris* L.	Herb	Moist	He	1565 m	Abundant	Wild
61	Lythraceae	*Punica grantum* L.	Tree	Moist	Ph	1651 m	Abundant	Cultivated
62	Malvaceae	*Alcea rosea* L.	Herb	Sandy	Th	1682 m	Abundant	Wild
63	Malvaceae	*Malva verticillata* L.	Herb	Moist	Th	1702 m	Abundant	Cultivated
64	Moraceae	*Ficus caria* L.	Tree	Dry/moist	Ph	1801 m	Abundant	Cultivated
65	Moraceae	*Morus alba* L.	Tree	Moist	Ph	1514 m	Abundant	Cultivated
66	Moraceae	*Morus nigrum* L.	Tree	Moist	Ph	1562 m	Abundant	Cultivated

Table 1: Continued

Table 1: Continued

67	Onagraceae	*Epilobium hirsutum*	Herb	Moist	He	1619 m	Rare	Wild
68	Onagraceae	*Oenothera affinis Cambess.*	Herb	Moist	Th	1714 m	Rare	Wild
69	Oxalidaceae	*Oxalis corniculata* L.	Herb	grasslands	Th	2000 m	Abundant	Wild
70	Pinaceae	*Pinus wallichiana* A.B. Jacks.	Tree	Dry	Ph	1302 m	Frequent	Wild
71	Plantaginaceae	*plantago lagopus* Linn.	Herb	Moist	Th	1603 m	Abundant	Cultivated
72	Plantaginaceae	*Plantago lancelota* L.	Herb	Dry	He	1675 m	Abundant	Wild
73	Plantaginaceae	*Plantago major* L.	Herb	Moist/terrestrial	He	1653 m	Abundant	Wild
74	Plantaginaceae	*Plantago ovata* Forssk.	Herb	Moist	Th	1908 m	Abundant	Wild
75	Plantaginaceae	*Veronica Persica* Poir.	Herb	Moist	Th	1489 m	Frequent	Wild
76	Platanaceae	*Platanus orientalis* L.	Tree	River sides	Ph	1585 m	Frequent	Wild
77	Poaceae	*Avena Sativa* L.	Herb	Moist	Th	1692 m	Abundant	Cultivated
78	Poaceae	*Dichanthium annulatum* (Forssk.) Stapf	Herb	terrestrial	He	1808 m	Abundant	Wild
79	Poaceae	*Festuca rubra* L.	Herb	Moist/dry	He	1376 m	Abundant	Wild
80	Poaceae	*Imperata cylindrica* (L.)	Herb	Moist	Th	1836 m	Frequent	Wild
81	Poaceae	*Phelum alpinum* L	Herb	Moist	He	1588 m	Abundant	Wild
82	Poaceae	*Phragmites karka* (retz.) trin. ex steud	Herb	Moist	He	1480 m	Abundant	Wild
83	Poaceae	*Poa annua* L.	Herb	Moist	Th	1588 m	Abundant	Wild
84	Poaceae	*Setaria viridis* L.P.Beavu.	Herb	Moist/dry	Th	1596 m	Abundant	Wild
85	Poaceae	*Sorghum halepense* Linn. Pers.	Herb	Moist	Ge	1483 m	Abundant	Wild
86	Poaceae	*Stipa grotis* Nees	Herb	Dry	He	2172 m	Frequent	Wild
87	Poaceae	*Triticum aestivum* L.	Herb	Moist	Th	1586 m	Abundant	Cultivated
88	Poaceae	*Zea mays L.*	Herb	Moist	Th	1638 m	Abundant	Cultivated
89	Polygonaceae	*Fagopyrum esculentum* Moench	Herb	Moist	Th	1977 m	Rare	Wild
90	Polygonaceae	*Persicaria pensylvanica* (L.)	Herb	Moist	Th	1962 m	Abundant	Wild
91	Polygonaceae	*Polygonum aviculare* L.	Shrub	Moist	Th	1530 m	Abundant	Wild
92	Polygonaceae	*Rumex hastatus* D. Don	Shrub	Dry/moist	Ph	1489 m	Abundant	Wild
93	Polygonaceae	*Rumex nepalensis* Spreng.	Herb	Moist	He	1702 m	Abundant	Wild
94	Pteridaceae	*Adiantum capillus veneris* L.	Herb	Moist	He	1575 m	Abundant	Wild
95	Rosaceae	*Cydonia oblonga* Mill.	Tree	Moist	Ph	1625 m	Abundant	Cultivated
96	Rosaceae	*Eriobotryo japonica* (Thunb.) Lindl.	Tree	Moist	Ph	1662 m	Frequent	Cultivated
97	Rosaceae	*Fragaria x ananassa* Duchesne ex Weston	Herb	Moist	He	1622 m	Frequent	Cultivated
98	Rosaceae	*Malus pumila* Mill.	Tree	Most	Ph	1600 m	Abundant	Cultivated
99	Rosaceae	*Potentilla norvegica* L.	Herb	Sandy	Th	1785 m	Frequent	Wild
100	Rosaceae	*Potentilla simplex* var. calvescens Fernald	Herb	Moist/dry	He	1447 m	Abundant	Wild
101	Rosaceae	*Prunus armeniaca* L.	Tree	Moist	Ph	1812 m	Abundant	Cultivated
102	Rosaceae	*Prunus avium* L.	Tree	Moist	Ph	1587 m	Abundant	Cultivated
103	Rosaceae	*Prunus Domestica* L.	Tree	Moist	Ph	1638 m	Abundant	Cultivated
104	Rosaceae	*Prunus dulcis* Mill.	Tree	Moist	Ph	1801 m	Abundant	Cultivated
105	Rosaceae	*Pyrus communis* L.	Tree	Moist	Ph	1432 m	Abundant	Cultivated
106	Rosaceae	*Rosa macrophylla* Lindl.	Shrub	Moist	He	1706 m	Rare	Wild
107	Rubiaceae	*Oldenlandia corymbosa* L.	Herb	Moist	Th	1522 m	Rare	Wild
108	Salicaceae	*Populus alba* L.	Tree	Moist	Ph	2073 m	Abundant	Wild
109	Salicaceae	*Populus nigra* L.	Tree	Dry	Ph	1641 m	Abundant	Wild
110	Salicaceae	*Salix alba* L.	Tree	River/wet	Ph	1902 m	Abundant	Wild
111	Simaroubaceae	*Ailanthus altissimus* Mill Swingle	Tree	Moist	Ph	1778 m	Abundant	Wild
112	Solanaceae	*Datura stramonium* L.	Herb	Moist/sandy	Th	2142 m	Abundant	Wild
113	Solanaceae	*Lycopersicon esculentum* L.	Shrub	Moist	Ph	1984 m	Abundant	Cultivated
114	Solanaceae	*Solanum nigrum* L.	Herb	Dry	He	1503 m	Frequent	Wild
115	Solanaceae	*Solanum tuberosum* L.	Herb	Moist	Th	1656 m	Abundant	Cultivated
116	Tamaricaceae	*Tamarix gallica* L.	Shrub	Dry/moist	He	1428 m	Frequent	Wild
117	Urticaceae	*Urtica dioica* L.	Herb	Moist	He	1412 m	Abundant	Wild
118	Vitaceae	*Vitis alba* L.	Sub-shrub	Moist	Ch	1905 m	Abundant	Cultivated
119	Zygophyllaceae	*Pegnum harmala* Linn.	Herb	Dry/moist	He	2188 m	Abundant	Wild

*Life form; Th therophytes, He hemicryptophytes, Ph phanerophytes, Ch chaemephytes, Ge geophytes

Stand-3

Stand 3 revealed notable floral diversity with a total of 26 species from 25 genera across 13 families. Herbs prevailed as the most abundant, with 16 species (62%), followed by 6 shrub species (23%), and 4 tree species (15%). Upon closer examination of life forms, both hemicryptophytes and therophytes emerged as dominant categories, each representing 9 species (35%). Phanerophytes comprised 7 species (27%), while chamaephytes had 1 species (4%), as shown in Fig. 7.

Simpson's diversity index (SID)

Our study on plant diversity, as measured by the Simpson index, yielded intriguing results. Stand 2 showed the highest diversity (0.961), followed by stand 1 (0.957), while stand 3 had the lowest diversity (0.939). Across the entire study site, the diversity index was 0.952, underscoring the rich variety of plant life. These findings illuminate the study area's vibrant ecological landscape. The details are shown in Fig. 8.

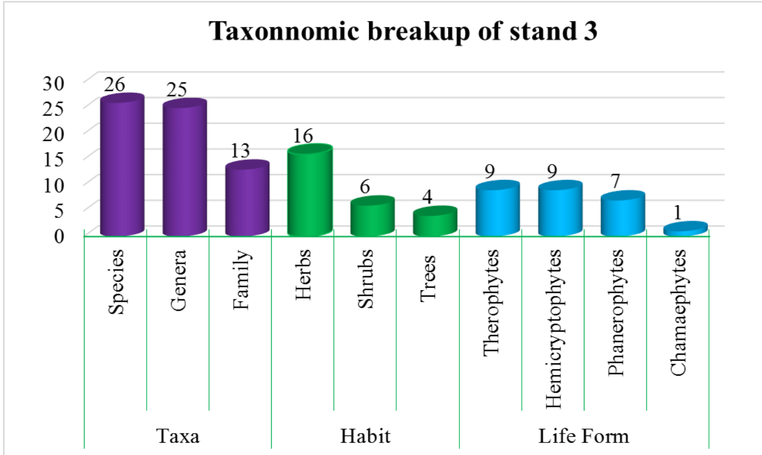

Fig. 7: the taxonomic breakdown observed in stand 3

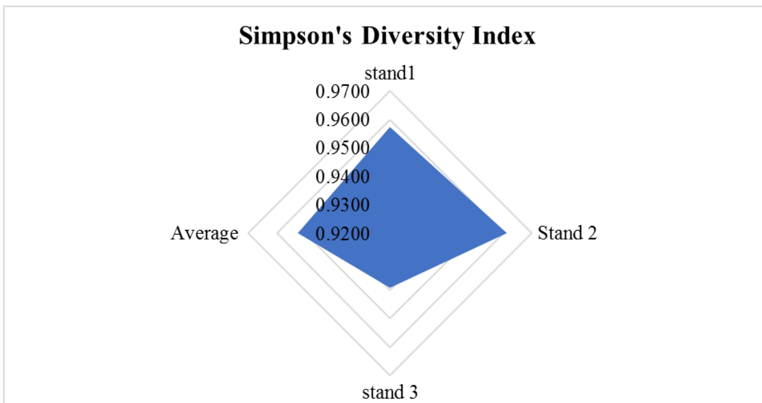

Fig. 8: Indicates diversity across all stands using the Simpson Diversity Index

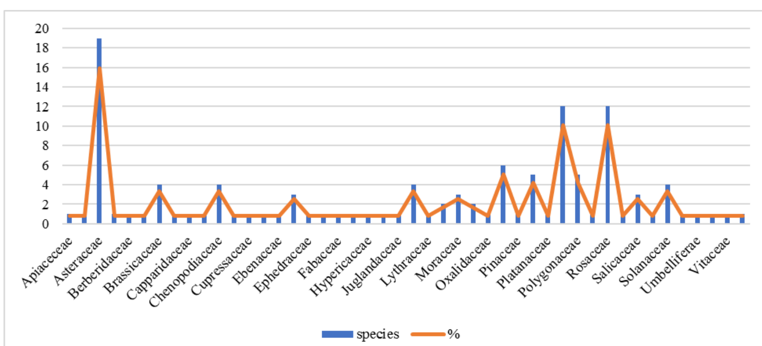

Fig. 9: Dominant families with species percentages

Discussion

The current study was conducted in the Nomal Valley, District Gilgit, and Gilgit Baltistan. The study focused on the phytoclimatic spectrum of weed flora. Bioclimatology, which includes phenology, is an ancient science that investigates the relationship between living organisms and climates (Chiou *et al.* 2015). Chavda and Mehta (2019) also found that the bioclimates of the area reflect the life forms of different regions of the country. The investigation methodically recorded the baseline inventory of 119 phanerogam species, spanning 99 genera and distributed across 46 families. The dominant families present in the current study area, where the family Asteraceae was the dominant taxa with 19 species, followed by the families Rosaceae and Poaceae each with 12 species,

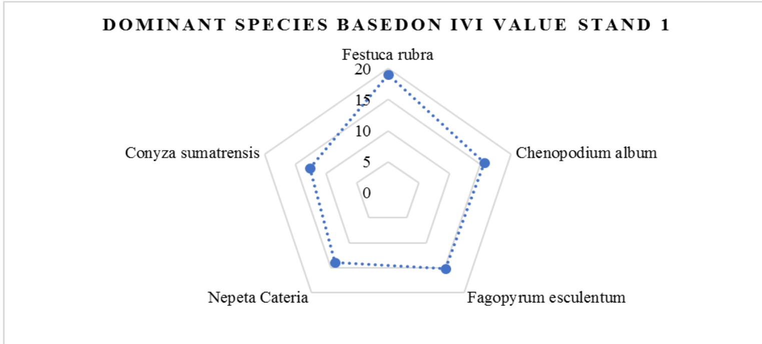

Fig. 10: Top five dominant species based on importance value index stand 1

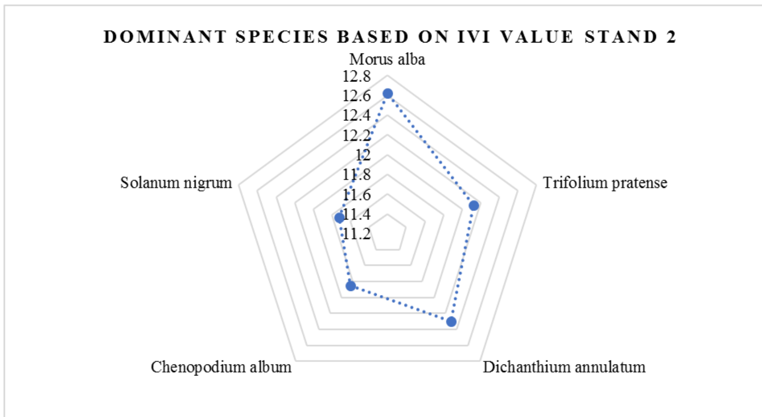

Fig. 11: The leading five species with the highest Importance Value Index (IVI) in stand 2

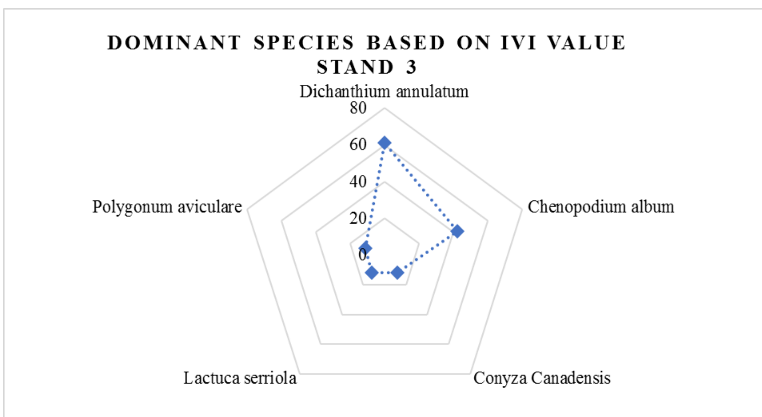

Fig. 12: The top five species in stand 3, are determined by their Importance Value Index (IVI)

and Papilionaceae with 6 species, are depicted in Fig. 9. Our findings, similar to those of Idrees *et al.* (2021), recorded that the most dominant families' taxa were Asteraceae with 42 species, followed by Rosaceae with 16 species, Poaceae with 9 species and Papilionaceae with 10 species. Another study conducted in Bin Dara, Western Boundary of Pakistan, documented in their findings that there were 47 families and 140 species (Manan *et al.* 2022).

The habit categories were classified into herbs, shrubs, sub-shrubs, and trees from the documented flora. Herbaceous plants emerged as the dominant habit category, comprising 78 species (66%), 23 tree species (19%), 14 shrubs species (12%) and 4 sub-shrubs species (3%). Whereas the research conducted by Haider and Ibrahim (2022) in Khujarab National Park, Gilgit-Baltistan, Pakistan, found that, the most prevalent habit category was herbs, 137 (88%), followed by 14 shrubs (9.03%), sub-shrubs, and trees, which comprise 2 species. The life form of vegetation in a region is always indicative of plant-environment interactions (Khan *et al.* 2013).

The life forms of weed flora in our study area were studied with the help of the Raunkiaer 1934 classification. The analysis of life form categories revealed the occurrence of therophytes with 46 species (39%), hemicryptophytes with 43 species (36%), and phanerophytes with 28 species (23%). Chamaephytes and geophytes each represented one species (1%). The research conducted by Idrees *et al.* (2021) showed similar findings in their studies. The life form of vegetation in a region is always indicative of plant-environment interactions. In our study, the dominance of therophytes and hemicryptophytes indicated the hot and cold xerophytic climatic conditions. It means hot in summer and cold in winter (Khan *et al.* 2013). Substantial anthropogenic and biotic pressures, notably grazing and human disturbances were highlighted. This highlighted the vulnerability of the local ecosystem to external influences (Ullah and Badshah 2017; Manan *et al.* 2022). While phytosociology involved investigating the attributes, classification, interconnections, and geographical spread of plant communities, it also aimed to articulate the diversity of species within these plant communities (Haq *et al.* 2015). The dominant taxa were categorized based on the importance value index in each documented stand. In Stand-1, the highest importance value was for Poaceae (*Festuca rubra* with a value of 19.08), depicted in Fig. 10. Stand-2 with Moraceae (*Morus alba* with a value of 12.62), shown in Fig. 11, and Stand-3 was with Poaceae (*Dichanthium annulatum* with value of 61.18), depicted in Fig. 12. It displayed a high association between vegetation and environmental conditions, enabling us to discover the complicated relations among ecosystem parts by studying resources and the environment (Iqbal *et al.* 2018). The ecological significance of the herbaceous layer in ecosystems is that it provides food and shelter and regulates energy flow and the nutrient cycle for all living beings (Haider and Ibrahim 2022).

Conclusion

In conclusion, the study conducted in Nomal Valley, Gilgit Baltistan, Pakistan, revealed a rich diversity of weed flora, comprising 119 species from 99 genera across 46 families. Dominant families included Asteraceae, Rosaceae, and Poaceae. Herbaceous plants were prevalent, with therophytes and hemicryptophytes being the dominant life forms. The dominance of therophytes showed that the area has a dry and desert climate while being close to hemicryptophytes, which showed a temperate region (Cain and Castro 1959). The study area into stands highlighted varied floral compositions and habitat preferences, with each stand exhibiting distinct dominant taxa based on the Importance Value Index (IVI).

It is essential to initiate studies within the agroecosystem, as they play a critical role in assessing both the present and future phytoclimatic conditions of the study area.

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Author Contributions

NZ, SH, and SK led research design, specimen collection, and data analysis, while MZ, MH, and AA collected specimens and images. K, S and RA meticulously preserved specimens. Each member's expertise was vital to our research success.

Conflicts of Interest

The authors of this paper declare no conflict of interest.

Data Availability

The corresponding author will provide access to the data from this study upon a justifiable request.

Ethical Approval

Not applicable to this paper.

References

Abbas Q, SW Khan, S Khatoon, SA Hussain, SN Hassan, A Hussain, R Qureshi, I Hussain (2014). Floristic biodiversıty and traditional uses of medicinal plants of Haramosh Valley Central Karakoram National Park of Gilgit district, Gilgit-Baltistan. *Pak J Biodivers Environ Sci* 5:75-86

Ali SI, M Qaiser (1986). A phytogeographical analysis of the phanerogams of Pakistan and Kashmir. *Proc Roy Soc Edinb Sect B Biol Sci* 89:89–101

Biase DL, L Pace, C Mantoni, S Fattorini (2021). Variations in plant richness, biogeographical composition, and life forms along an elevational gradient in a Mediterranean Mountain. *Plants* 10:2090-2109

Cain SA, GMD Castro (1959). *Manual of Vegetation Analysis,* p: 55. Harper New York

Chavda NH, SK Mehta (2019). Life forms and biological spectrum of the Bhandaria Forest Area in Bhavnagar, Gujarat, India. *Intl J Sci Res* 10:34369–34371

Chiou CR, TY Hsieh, CC Chien (2015). Plant bioclimatic models in climate change research. *Bot Stud* 56:1–12

Curtis JT, RP Mcintosh (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology* 31:434–455

Haider S, N Ibrahim (2022). Ecological Significance of floristic structure and Biological Spectrum of alpine floral biodiversity of Khunjerab National Park Gilgit-Baltistan Pakistan. *Intl J Innov Sci Technol* 4:564–577

Haq F, H Ahmad, Z Iqbal (2015). Vegetation description and phytoclimatic gradients of sub-tropical forests of Nandiar Khuwar catchment District Battagram. *Pak J Bot* 47:1399–1405

Idrees M, WM Khan, H Khan, A Iqbal, N Umar, K Shah, A Nisar (2021). Phytoclimatic Spectrum of Weeds Flora of Toormang Valley, Dir Lower, Koh-e-Hindukush Range, Pakistan. *Pak J Weed Sci Res* 27:451–473

Ilyas S, J Moncrieff (2012). Trends in prescriptions and costs of drugs for mental disorders in England, 1998–2010. *Brit J Psychiatry* 200:393–398

Iqbal Z, A Zeb, EFA_Allah, IU Rahman, SM Khan, N Ali, F Ijaz, YAU Haq, S Muzammil, AA Alqarawi, A Hashem, A Afzal, A Majid, MA Khan, ES Calixto (2018). Ecological assessment of plant communities along the edaphic and topographic gradients of biha valley, District Swat, Pakistan. *Appl Ecol Environ Res* 16:5611–5631

Jahangeer AB, K Munesh, AP Nazir, S Shipra, D Suchindra, G Champathi, KN Ajeet (2020). Influence of altitude on the distribution pattern of flora in a protected area of Western Himalaya. *Acta Ecol Sin* 40:30–43

Karima, S Hyder, S Khadim, N Zehra, Shahnaz, Zeshan, R Ali, A Abbass (2024). Analyzing phytoecological significance of floral biodiversity in Rahim Abad, District Gilgit, Pakistan. *Intl J Agric Biol* 31:235–242

Khadim S, T Khan (2021). An Allometric growth estimation study of *Prunus armeniaca* L. collected from Danyore Valley, district Gilgit. *Nat Sci* 19:41–43

Khadim S, H Sujjad, Z Tehseen, A Hasnain (2024). Ethnobotanical inventory and indigenous therapeutic applications of wild medicinal plants in Parishing valley, District Astore, Gilgit-Baltistan, Pakistan. *Ethnobot* 28:1–26

Khan SM, P Sue, A Habib, S Hamayun, A Mushtaq, D Harper (2013). Phyto-climatic gradient of vegetation and habitat specificity in the high elevation western Himalayas. *Pak J Bot* 45:223–230

Majeed M, AM Khan, T Habib, MM Anwar, HA Sahito, N Khan, K Ali (2022). Vegetation analysis and environmental indicators of an arid tropical forest ecosystem of Pakistan. *Ecol Indicat* 142:109291

Manan F, SM Khan, Z Muhammad, Z Ahmad, A Abdullah, AY Rahman, H Han, A Ariza-Montes, N Contreras-Barraza, A Raposo (2022). Floristic composition, biological spectrum, and phytogeographic distribution of the Bin Dara Dir, in the western boundary of Pakistan. *Front For Glob Change* 5:1-16

Nohro S, S Jayakumar (2020). Tree species diversity and composition of the Pala Wetland Reserve Forest, Mizoram, Indo-Burma hotspot, India. *Biocatal Agric Biotechnol* 23:1-7

Onoda Y, IJ Wright, JR Evans, K Hikosaka, K Kitajima, Ü Niinemets, H Poorter, T Tosens, M Westoby (2017). Physiological and structural tradeoffs underlying the leaf economics spectrum. *New Phytol* 214:1395–1397

Patel AH, BK Jain, YB Dabgar (2010). Life form and phyto climate of Sebhargog region, North Gujarat, India. *Plant Arch* 10:965–966

Raunkiaer C (1934). *The life forms of plants and statistical plant geography; being the collected papers of C. Raunkiaer*. Clarendon Press, Oxford, UK

Saqib Z, RN Malik, MI Shinwari, ZK Shinwari (2011). Species richness, ethnobotanical species richness and human settlements along a Himalayan altitudinal gradient: Prioritizing Plant Conservation in Palas Valley, Pakistan. *Pak J Bot* 43:129–133

Schmidt M, H Kreft, A Thiombiano, G Zizka (2005). Herbarium collections and field data-based plant diversity maps for Burkina Faso. *Divers Distrib* 11:509–516

Sekar KC, N Thapliyal, A Pandey, B Joshi, S Mukherjee, P Bhojak, M Bisht, D Bhatt, S Singh, A Bahukhandi (2023). Plant species diversity and density patterns along altitude gradient covering high-altitude alpine regions of west Himalaya, India. *Geol Ecol Landsc* pp:1–15

Shaheen H, ZK Shinwari (2012). Phyto diversity and endemic richness of Karambar lake vegetation from Chitral, Hindukush-Himalayas. *Pak J Bot* 44:17–21

Shaheen H, ZK Shinwari, RA Qureshi, Z Ullah (2012). Indigenous plant resources and their utilization practices in village populations of Kashmir Himalayas. *Pak J Bot* 44:739–745

Simpson EH (1949). Measurement of diversity. *Nature* 163-688

Ullah S, L Badshah (2017). Floristic structure and ecological attributes of Jelar valley flora, district Upper Dir, Pakistan. *J Biodivers Environ Sci* 10:89–105

Yatsenko V, O Ulianych, S Shchetyna, G Slobodyanyk, N Vorobiova, Z ovtunyuk, L Voievoda, V Kravchenko, O Lazariev (2021). Floral diversity and phytosociological studies on vegetation of Agror Valley, District Mansehra. *Ukr J Ecol* 11:84–93