Available online at www.worldscientificnews.com

World Scientific News

WSN 87 (2017) 136-149 EISSN 2392-2192

Biological spectra of vegetation of Sathan Gali, Mansehra, KPK, Pakistan

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ABSTRACT

The present study was carried out to assess the biological spectra of the existing vegetation of Sathan Galli, District Mansehra of Khyber Pakhtoonkhawa (KPK) Pakistan. In this study, area under investigation was divided into 33 stands on the basis of physiognomic characteristics of the vegetation. A total of 105 plant species of 55 families were recorded. The leaf size spectra was dominated by Microphyll contributing 68 species, followed by Mesophylls 45 species, Nanophyll 41 species, Macrophyll and Leptophylls l7 species. Therophytes were found as leading life form of the area encompassing 30.35% species, followed by Hemicryptophytes 20.23% and Megaphanerophytes 16.66%. The biological spectra indicating prevailing climatic conditions of the area and adaptation of vegetation to these conditions. The finding of current exploration revealed that Therophytes and Microphyll were dominant in the study area depicting heavy biotic pressure due to deforestation, over grazing and soil erosion.

***Keywords*:** Biological spectrum, Therophytes, Sathan Gali, Mansehra, Pakistan

1. INTRODUCTION

The study area, Sathan Gali can be located between 34.36132 to 34.36650 North and 073.11067 to 073.12488 East longitude in district Mansehra of Khyber Pakhtoonkhawa (KPK) Pakistan. The district Mansehra is an important part of internationally recognized provenice of western Himalaya. The district has three sub divisions viz Mansehra, Balakot, and Oghi. Mansehra is surrounded by the North to Kohistan and Battagram districts, by the East to Muzaffarabad district of Azad Kashmir, by the South to Abbottabad and Haripur districts and by the West to Shangla and Buner Districts (Fiaz, 2012). Heavy rain fall occurs in winter and Monsoon whereas the temperature of the area remains pleasant round the year. However, temperature rises slightly in May and June (Khan *et al*. 2016).

The biological spectra is one of the significant physiognomic attributes characterizing vegetation used extensively in analyzing vegetation (Raunkiar, 1934). Leaf size study is a valuable tool in describing the plant communities (Oosting, 1956). This is first comprehensive study based on biological spectra of plants of the area which will contribute a lot to the scientific communities and forest preservation (Lilian-Lee *et al*, Guariento *et al*, Petrie *et al*, Urza *et al*, Fernández-Pascual *et al*, Venier *et al*, Pulgar *et al*, Perea *et al*, Vítová *et al*, Alcántara *et al*, 2017)

2. MATERIALS AND METHODS

Fig. 1. Author in field while documenting data.

The frequent field visits were conducted in order to investigate the Phytosociological attributes of Sathan Gali, Mansehra, Northern Pakistan during 2013-2015. The area was divided into 33 stands on the basis of physical appearance of vegetation.

Quadrate method was applied for sampling the vegetation. The size of Quadrats was 10×2 m^2 , 5×2 m^2 and 1×1 m^2 for trees, shrubs and herbs respectively (Malik, 1986).

The number of quadrates laid down at each sampling stand was 5 for trees, 10 for shrubs and 20 for herbs. Plants specimens in triplicate were collected, pressed, dried, poisoned and affixed on standard sized herbarium sheets.

The specimens were identified with the help of Flora of Pakistan (Nasir and Ali, 1971-1994; Ali and Qaisar, 1995-2004). Voucher specimens' numbers were allotted and deposited in the Herbarium of department of Botany, Government College Mansehra, KP, Pakistan for future references and studies. The life form classes and leaf spectra of all plant species were determined and classified in according to Raunkiaer (1934) and Mueller-Dombois and Ellenberg (1974).

3. RESULTS

Life form

A total of 170 plant species were assigned different life form classes. The Therophytes were dominant life form of the vegetation of study area, contributing 51 plant species, followed by Hemicyptophytes 34 species, Megaphanerophytes 28 species, Geophytes and Nanophanerophytes 21 species each, Chamaephytes 12 and Leptophylls by 1 species (Table 1).

Table 1. Percentage of life form classes of plant species of Sathan Galli.

Life form classes	No. of species	Percentage (%)
TH	51	30.35
H	34	20.23
MP	28	16.66
GE	21	12.5
NP	21	12.5
CH	12	7.14
L	1	0.59

Leaf Spectra

The leaf size spectra was dominated by Microphylls contributing 68 plant species followed by Mesophylls containing 45 plant species, Nanophylls 41 species, Macrophylls 7 species and Leptophylls by 7 species (Table 2).

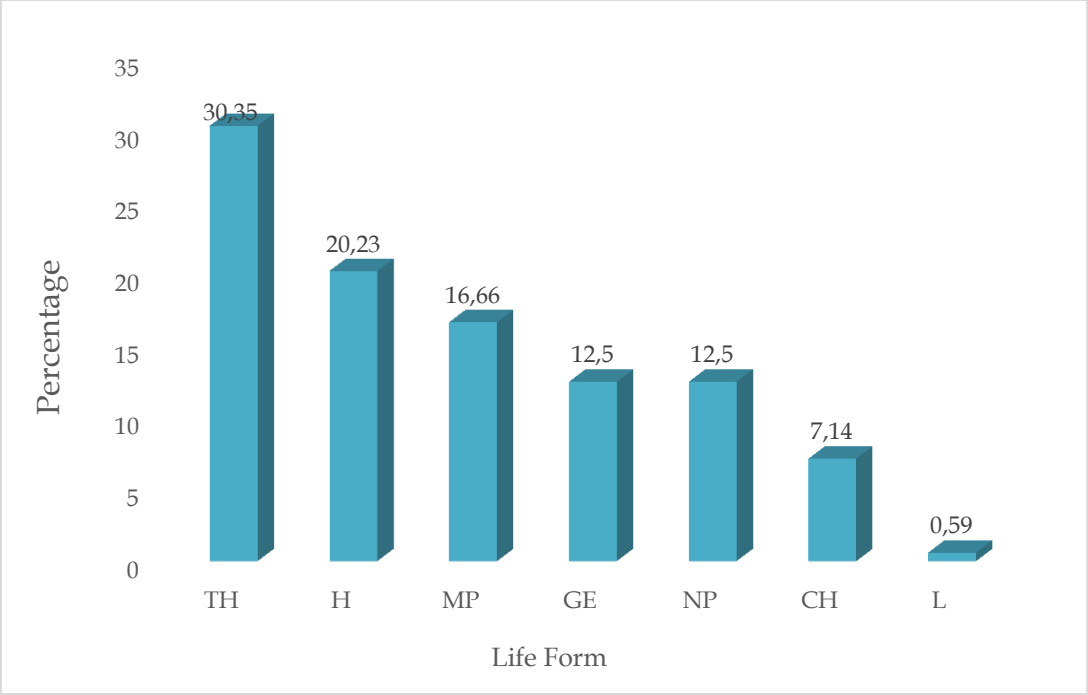

Fig. 2. Graphical representation of life form classes of Sathan Galli.

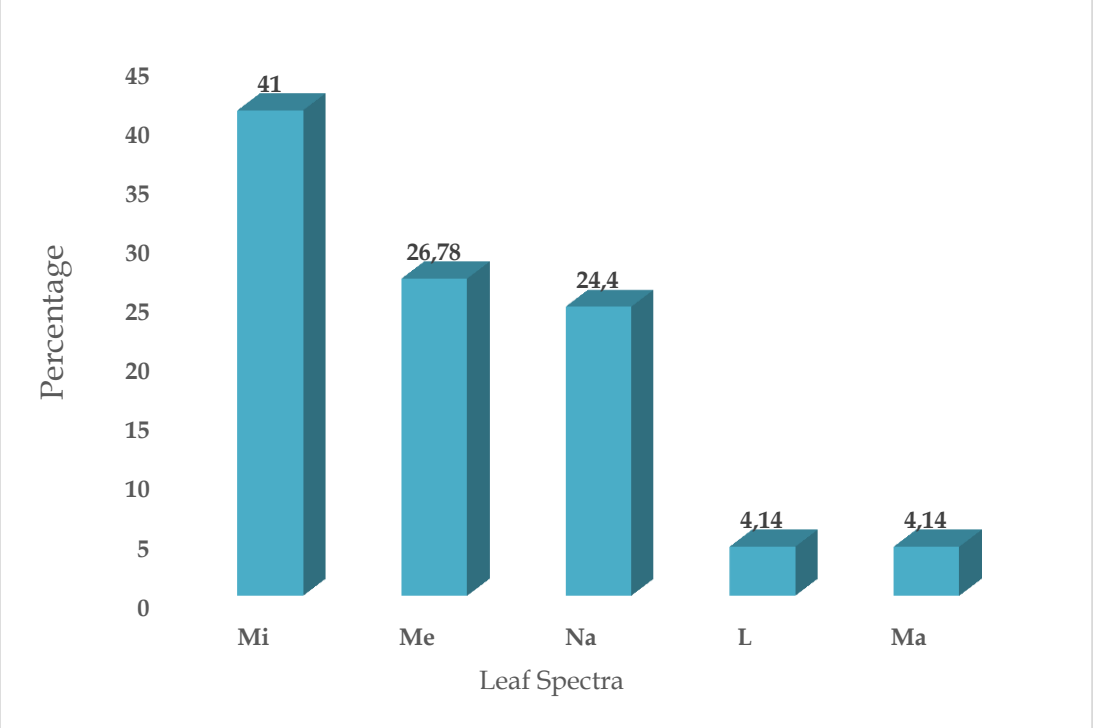

Fig. 3. Graphical representation of leaf spectra of Sathan Galli.

Table 2. Classification of Leaf spectra of plant species of Sathan Galli.

Leaf spectra classes	No. of species	Percentage (%)
Mi	68	41
Me	45	26.78
Na	41	24.40
L	7	4.14
Ma	7	4.14

4. DISCUSSION AND CONCLUSIONS

Biological spectra depict prevailing environmental conditions of an area. This important phytosociological attribute was assessed in the current investigation. The study of plant life forms is imperative, because it provides the basic structural composition of vegetation and describes vegetation structure of a region (Box, 1981). The life form of plants is an adaptive response to environmental gradients and indicator of habitat prevailing conditions (Archibold, 1995). Analogous biological spectra in different regions show similar climatic conditions. Biological spectra are helpful in comparing geographically distant plant association and indication of prevailing environment.

The biological spectrum was dominant by Therophytes 30.35% followed by hemicryptophytes 20.23%. The dominance of Therophytes in the study area revealed that the investigated area is under heavy biotic pressure owing to deforestation, over grazing and soil erosion. The present findings are in close agreement with Shaheen *et al.* (2016), who also reported Therophytes as the leading life form in Havelian, district Abbottabad, Pakistan. Malik *et al.* (1994) and Malik *et al.* (2001) found that in the moist temperate part of Dhirkot and Neelum valleys of Kashmir region, hemicryptophytes and therophytes were the dominant lifeform classes. The findings of our study are in accordance with other studies (Sher and Khan, 2007; Shah and Husain, 2008). Hussain *et al.* (2015) also reported that Therophytes were leading lifeform in their study area.

However, our findings are not in agreement with Malik (2005) who reported hemicryptophytic and therophytic species were dominating in Ganda Chotti and Bedori hills at an elevation of 1700–3700 m. The reson is that our study area is unprotected where anthropogenic effects upset the vegetation structure.

Leaf spectra are characteristic of the existing environmental and habitat conditions of any area (Hussain *et al*. 2015). The leaf size spectrum was dominated by Microphylls contributing 40.47% species, followed by Mesophylls containing 26.78% species. Malik *et al.* (2007) found microphyllous and nanophyllous as the dominant leaf size from Kotli Azad Kashmir and Waziristan. Martins (2004) also investigated the positive correlation of leaf size with drought and soil condition. Malik *et al.* (2007) and Badshah *et al.* (2010) found microphyllous and nanophyllous as the dominant leaf size from Kotli Azad Kashmir and

Waziristan. Sher & Khan (2007) stated greater percentage of leptophylls and nanophylls from Chagarzai area. This disagreement is mainly owing to variation in elevation and habitat condition. The situation in our case is generally moist and cold which favours microphyllous flora of an area. Whereas dominance of leptophylls and nanophylls supporting xeric type conditions.

Table 3. Life Form and Leaf Spectra of different Plant Species recorded from Sathan Galli.

S. No	Botanical Name	Family	Habit	Life form	Leaf spectra
1	*Abies pindrow* Royle.	Pinaceae	Tree	MP	Na
2	*Arisaema jacquemontii* Blume	Araceae	Herb	GE	Me
3	*Achillea mellefolium* L.	Asteraceae	Herb	H	Mi
4	*Adiantum capillus veneris* L.	Adiantaceae	Herb	GE	Mi
5	*Adiantum caudatum* L.	Adiantaceae	Herb	GE	Ma
6	*Aegopodium burttii* E. Nasir	Apiaceae	Herb	TH	Mi
7	*Aesculus indica* (Comb.) Hook	Hippocastinaceae	Tree	MP	Ma
8	*Agrostis stolonifera* L.	Poaceae	Herb	H	Na
9	*Ajuga bracteosa* Wall.ex Benth.	Labiatae	Herb	TH	Me
10	*Ajuga parviflora* Benth.	Labiatae	Herb	TH	N
11	*Alianthus althesema* (Mill.) Swingle	Simaroubaceae	Tree	MP	Mi
12	*Alnus nitida* (Spach.) Endl.	Betulaceae	Tree	MP	Me
13	*Anagallis arvensis* L.	Primulaceae	Herb	TH	Na
14	*Andrachne cordifolia* (Wall.ex Dec.) Muell.	Euphorbiaceae	Shrub	NP	Mi
15	*Androsace rotundifolia* Hardw.	Primulaceae	Herb	TH	Mi
16	*Anaphalis busua* DC.	Asteraceae	Herb	TH	Na
17	*Apluda* sp.	Poaceae	Herb	H	Mi
18	*Aquilegia pubiflora* Wall.ex Royle	Ranunculaceae	Herb	TH	Me
19	*Arisaema flavum* Forssk.	Araceae	Herb	GE	Me
20	*Arisaema utile* Hook.fex. Schott.	Urticaceae	Herb	Th	Mi
21	*Aristida* sp.	Poaceae	Herb	H	Mi
22	*Artemisia absintium* L.	Asteraceae	Herb	H	Me

23	*Arum* sp.	Areaseae	Herb	GE	MI
24	*Asparagus filicinus* Bunch –Ham.ex D.Don	Asparagaceae	Herb	GE	Mi
25	*Aster himalaicus* C.B.Clarke	Asteraceae	Herb	TH	Mi
26	*Bauhinia variegata* L.	Caesalpinaceae	Tree	MP	Me
27	*Berberis lycium* Royle	Berberidaceae	Shrub	NP	Na
28	*Bergenia ciliata* Sternb.	Saxifragaceae	Herb	GE	Me
29	*Bistorta amplexicaule* (D.Don) Greene.	Polygonaceae	Herb	H	Me
30	*Bromus japonicus* Thunb.	Poaceae	Herb	H	L
31	*Brachiaria ramose* (L.) Stapf	Poaceae	Herb	H	Na
32	*Buddleja crispa* Benth.	Buddlejaceae	Shrub	NP	Mi
33	*Bupleurum lanceolatum* Wall. ex DC.	Apiaceae	Herb	H	Me
34	*Calamintha umbrosa (*M.B) Bth. ex DC.	Labiateae	Herb	H	Mi
35	*Calandula arvensis* L.	Asteraceae	Herb	TH	MI
36	*Caltha alba* Camb.	Ranunculaceae	Herb	H	Me
37	*Cannabis sativa* L.	Cannabinaceae	Herb	TH	Mi
38	*Capsella bursa- pistoris (*L) Medik	Brassicaeae	Herb	TH	L
39	*Cedrus deodara* Roxb. ex Lamb.	Pinaceae	Tree	MP	Na
40	*Celtis australis* L.	Ulmaeae	Tree	MP	Mi
41	*Chenopdium ambrosiodes* L.	Chenopodiaceae	Herb	Th	L
42	*Chenopodium album* L.	Chenopodiaceae	Herb	Th	Na
43	*Cichorum intybus* L.	Asteraceae	Herb	H	Mi
44	*Clinopodium vulgare* L.	Lamiaceae	Herb	H	Mi
45	*Colchicum luteum* Baker	Colchicacea	Herb	GE	Mi
46	*Convulvulus arvensis* L.	Convulvulaceae	Herb	TH	Mi
47	*Conyza canadensis* L. Cronquist.	Asteraceae	Herb	TH	Na
48	*Cotoneaster* sp.	Rosaceae	Shrub	NP	Na
49	*Crotolaria* sp.	Fabaceae	Herb	H	Mi
50	*Cynodon dactylon* (L.)Pers.	Poaceae	Herb	H	Na
51	*Cyperus* sp.	Cyperaceae	Herb	CH	Mi

52	*Daphne papyracea* Wall. ex Steud.	Thymelaeaceae	Shrub	NP	Na
53	*Desmodium elegans* DC.	Papilionaceae	Shrub	NP	Me
54	*Deutzia staminea R.* Br .ex Wall.	Philadelphaceae	Shrub	NP	Mi
55	*Dicliptra bupleorides* Nees.	Acanthaceae	Herb	TH	Mi
56	*Digitaria nodosa P*erl.	Poaceae	Herb	H	Na
57	*Diospyros lotus* L.	Ebenaceae	Tree	MP	Me
58	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub	NP	Na
59	*Dryopteris stewartii* Fress	Pteridaceae	Herb	GE	Me
60	*Duchesnea indica* (Andr.) Focke.	Rosaceae	Herb	CH	Me
61	*Elymus* sp.	Poaceae	Herb	H	Na
62	*Erigeron multiradiatus* Lindley	Asteraceae	Herb	TH	Mi
63	*Fagopyrum* sp.	Polygonaceae	Herb	TH	MI
64	*Ficus carica* Forsk.	Moraceae	Tree	MP	Me
65	*Fragaria nubicola* Lindl.	Rosaceae	Herb	TH	Mi
66	*Fumaria indica* (Husskn.) H.N	Fumaraceae	Herb	TH	Na
67	*Gallium aparine* L.	Rubiaceae	Herb	TH	Na
68	*Gentianodes pedicellata* D.Don	Gentianaceae	Herb	TH	Na
69	*Geranium rotundifolium* L.	Geraniaceae	Herb	GE	Me
70	*Geranium wallichinum* D. Don ex Sweet.	Geraniaceae	Herb	Th	Na
71	*Hedra nepalensis* K. Koch.	Araliaceae	Herb	L	Me
72	*Heteropogon contortus L.*	Poaceae	Herb	H	Mi
73	*Hypericum perforatum* (L.) P.Beauv. ex Roem. & Schult.	Guttiferae	Herb	TH	Na
74	*Impatiens bicolor* Royle	Balsaminaceae	Herb	TH	Me
75	*Indigofera hetrantha* Wall.	Fabaceae	Herb	NP	Me
76	*Imprita cylindrica* (L.) .P.Beaiev.	Poaceae	Herb	H	L
77	*Inula coppa* L.	Asteraceae	Herb	H	Mi
78	*Isodon rugosus L.*	Labiatae	Shrub	NP	Mi
79	*Jasminum humile* L.	Oleaceae	Shrub	NP	Mi
80	*Juglans regia* L.	Juglandanceae	Tree	Mp	Me

81	*Lactuca* sp.	Asteraceae	Herb	H	Mi
82	*Lamium album* L.	Labiatae	Herb	TH	Mi
83	*Lamium amplexicaule L.*	Lamiaceae	Herb	TH	Mi
84	*Leontopodium brachyoctis* Gandoger	Asteraceae	Herb	CH	Na
85	*Leonurus cordiaca* L.	Lamiaceae	Herb	H	Mi
86	*Lonicera* sp.	Caprifoliaceae	Shrub	NP	Me
87	*Malva neglecta* Wallr.	Malvaceae	Herb	Th	Mi
88	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	Herb	CH	MI
89	*Medicago denticulata* Willd.	Papilionaceae	Herb	TH	Na
90	*Melia azedarach* L.	Meliaceae	Tree	MP	Me
91	*Micromeria biflora* Buch.	Labiatae	Herb	TH	Le
92	*Morus alba* L.	Moraceae	Tree	MP	Me
93	*Morus nigra* L.	Moraceae	Tree	MP	Me
94	*Myosotis arvensis* (L.) Hill.	Boraginaceae	Herb	H	Na
95	*Myrsine Africana* L.	Myrsinaceae	Shrub	NP	Na
96	*Nepeta cataria* L.	Labiatae	Herb	CH	Mi
97	*Oenothera rosea* L.	Onagraceae	Herb	TH	Na
98	*Onychium japonicum* (Kunze). Wall	Pteridaceae	Herb	GE	Na
99	*Origanum vulgare* L.	Labiatae	Herb	TH	Na
100	*Oxalis corniculata* L.	Oxalidaceae	Herb	TH	Na
101	*Paeonia emodi* Wall. ex Hook. f.	Paeoniaceae	Herb	GE	Ma
102	*Parrotiopsis jacquemontiana* Rehder.	Hamamelidaceae	Shrub	NP	Me
103	*Parthenium hysterophorus* L.	Asteraceae	Herb	H	Mi
104	*Phlomis rotata* Royle .ex Benth.	Labiatae	Herb	GE	Mi
105	*Picea smithiana* (Wall.) Boiss.	Pinaceae	Tree	MP	Na
106	*Pieris ovalifolia* (Wall.) D. Don	Ericaceae	Tree	MP	Me
107	*Pinus roxburghii* Surgent.	Pinaceae	Tree	MP	Na
108	*Pinus wallichiana* A. B. Jacks.	Pinaceae	Tree	MP	Na
109	*Plantago lanceolata* L.	Plantaginaceae	Herb	TH	Mi

110	*Plantago major* L.	Plantaginaceae	Herb	TH	Mi
111	*Platanus orientalis* L.	Platanaceae	Tree	MP	Ma
112	*Poa* sp.	Poaceae	Herb	H	Na
113	*Podophyllum emodi* Wall.ex Royle	Podophyllaceae	Herb	GE	Me
114	*Populus alba*.L.	Salicacae	Tree	MP	Me
115	*Potentilla nepalensis* Hook.f.	Rosaceae	Herb	H	Me
116	*Potentilla* sp.	Rosaceae	Herb	H	Me
117	*Primula denticulata* Sm.	Primulaceae	Herb	H	Me
118	*Prunella vulgaris* L.	Rosaceae	Herb	Ch	Mi
119	*Polygonatum verticillatum* (L.) All.	Asparagaceae	Herb	GE	Mi
120	*Prunus cornata* (Royle) Steudel	Rosaceae	Tree	MP	Me
121	*Pteridium* sp.	Pteridaceae	Herb	GE	Me
122	*Pteris* sp.	Pteridaceae	Herb	GE	Mi
123	*Pteris vitata* L.	Pteridaceae	Herb	GE	Mi
124	*Pulicaria crispa* (Forssk). Olive	Asteraceae	Herb	H	L
125	*Pyrus pashia* Ham.ex D. Don	Rosaceae	Tree	MP	Me
126	*Quercus dilatata* Lindle. ex Royle	Fagaceae	Tree	MP	Mi
127	*Quercus incana* Roxb.	Fagaceae	Tree	MP	Me
128	*Ranunculus hirtellus* Royle	Ranunculaceae	Herb	TH	Mi
129	*Ranunculus muricatus* L.	Ranunculaceae	Herb	Th	Mi
130	*Rhamnus virgata* Roxb.	Rhamnaceae	Tree	MP	Mi
131	*Rhododendron arboreum* Smith	Ericaceae	Tree	MP	Me
132	*Rosa moschata* J. Herm.	Rosaceae	Shrub	NP	Me
133	*Rubus fructicosus* Hook.f.	Rosaceae	Shrub	NP	Me
134	*Rumex nepalensis* Spreng.	Polygonaceae	Herb	H	Me
135	*Rumex dentatus* L.	Polygonaceae	Herb	H	Me
136	*Rumex hastatus* D. Don	Polygonaceae	Herb	H	Mi
137	*Salvia lanata* Roxb.	Labiatae	Herb	CH	Mi
138	*Sarcococca saligna* (Don) Muell.	Buxaceae	Shrub	NP	Mi

139	*Saromatum venosum* (Dryand. ex Aiton) Kunth	Areaseae	Herb	CH	Ma
140	*Scutellaria chamaedrifolia* Hedge	Labiatae	Herb	CH	Na
141	*Silene conidea* L.	Caryophyllaceae	Herb	TH	Na
142	*Skimmia laureola* D.C.	Rutaceae	Shrub	NP	Mi
143	*Senicio* sp.	Asteraceae	Herb	Th	Mi
144	*Solanum surratense* Burm.f.	Solanaceae	Herb	CH	Mi
145	*Solena amplexicaulis* (Lam.) Gandhi	Cucurbitaceae	Herb	GE	Mi
146	*Solidago virgaurea* L.	Asteraceae	Herb	H	Na
147	*Sonchus asper* (L.) Hill.	Asteraceae	Herb	Th	Me
148	*Sorbaria tomentosa* Lindl.	Rosaceae	Shrub	NP	Me
149	*Spiraea vaccinifolia* D. Don.	Rosaceae	Shrub	NP	Mi
150	*Stellaria media* (L.) Vill.	Caryophyllaceae	Herb	Th	Na
151	*Swertia ciliate* (D.Don ex G. D.Don)	Gentianaceae	Herb	H	Mi
152	*Taraxacum officinale* Weber.	Asteraceae	Herb	TH	Me
153	*Taxus wallichiana* Zuce.	Taxaceae	Tree	MP	Na
154	*Themeda anathera* (Nees ex Steud.) DC.	Poaceae	Herb	H	N
155	*Trifolium repens* L.	Paplionaceae	Herb	H	Na
156	*Tussilago farfara* L.	Asteraceae	Herb	TH	Ma
157	*Ulmus villosa* Brandis ex Gamble	Ulmaeae	Tree	MP	Mi
158	*Urtica dioica* L.	Urticaceae	Herb	TH	Mi
159	*Vaccaria* sp.	Caryophyllaceae	Herb	H	Mi
160	*Valeriana jatamansi* Jones.	Valerianaceae	Herb	GE	Me
161	*Verbascum thapsus* L.	Scrophulariaceae	Herb	H	Me
162	*Veronica persica* Poir.	Scrophulariaceae	Herb	TH	Mi
163	*Viburnum grandiflorum* Wall. ex DC.	Caprifoliaceae	Shrub	Np	Me
164	*Viola canescens* Wall. Ex Roxb.	Violaceae	Herb	TH	Mi
165	*Viola odorata* L.	Violaceae	Herb	TH	Mi
166	*Vitis jacquemontii* Roxb.	Vitaceae	Climber	NP	Mi
167	*Viburnum cotinifolium* D. Don	Caprifoliaceae	Shrub	NP	Mi

168	*Woodfordia* sp.	Lythraceae	Herb	NP	Ma
169	*Primula denticulata* Smith	Primulaceae	Herb	H	Mi
170	*Ziziphus jujuba* Mill.	Rhamnaceae	Shrub	NP	Mi

Acknowledgement

Authors are extremely thankful to Forest department for providing of required documents and equally grateful to in charge Herbarium Hazara University for facilitation in identification of plants.

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(Received 22 September 2017; accepted 06 October 2017)