Spectrum of the Flora of Proposed Alsindi Cement Plant

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ABSTRACT

The ecosystem of Himalayan region have immense mineral wealth. Limestone found in Himachal Pradesh. is an important industrial mineral. Therefore, the present work was undertaken to study the floristic composition at Alsindi Cement mining area in Mandi district of H.P. where Lafarage Cement [Ltd] Company is establishing a Cement factory and further to understand the life form spectrum of different plant species. A total of 76 species [22 trees, 18 shrubs, 4 climbers, 6 herbs, 4 grasses and 3 legumes] were found in this area. It was found that most of the species occurred at the HB [Hill base]. The life form spectrum recorded that 53% were phenerophytes, 18% therophytes and 29% hemigeophytes. When the present spectrum is compared with normal spectrum, it was found that phenerophytes, therophytes and hemigeophytes were more then normal spectrum, whereas geophytes and Chamaephytes were completely absent. A number of studies conducted earlier in different regions also show that it is not only the climate but biotic interference, also changes the life form and floristic composition of the area. Therefore, the primary strategy of the plants is survival by evolving wide range of life form patterns and occupy varied ecological niches in different area.

Keywords: Spectrum, Flora, Alsindi Cement Plant

INTRODUCTION

The ecosystem of Himalayan region thrive on the land, concealing immense mineral wealth, ranging from the most ordinary clay stones to precious metallic ores. Limestone found in Himachal Pradesh is an important industrial mineral extensively used in steel plants

and cement factories and annually about 75,000 million tones is extracted from nearly 603 limestone mines. The state is placed ninth by number of limestone mines *[Department of Industries, 2007]*. So far, Bilaspur and Sirmour are the two major limestone-producing districts, Mandi district has now received the attention for the same purpose as the Lafarge Cement India, one of the biggest cement industries in the world, proposes to establish a cement plant.

Plants [Flora] and the environment are closely related to each other. Plants compete with each other for nutrition and adjust among themselves either by adaptation or by modifying the environmental conditions that suits them for their continued existence. Thus, they develop a tolerance / adaptation to overcome the adverse conditions. Plant population in a community varies from habitat to habitat. With the change in environmental conditions, the vegetation cover reflects several changes in structure and composition. The component approach involving basic ecological types [i.e. life forms] in vegetation-environment studies permits better resolution of vegetation type, treatment of compositional continuum and succession modeling based on relative advantage of a particular life form. *Humboldt [1805],* was the first to formulate the concept of life forms, while *Golubev [1968],* described them as determinants of interactions, structure and dynamics of the components constituting the coenosis. *Raunkiaer [1934]*, expressed climate as the statistical distribution of life forms in the flora of the region. The life form composition appears to vary much less with climate than does species composition *[Box, 1981]*.

Therefore, the present study was undertaken to study the floristic composition in the proposed Alsindi Cement mining area in Mandi District of Himachal Pradesh and understand the life forms.

DESCRIPTION OF STUDY AREA

Himachal Pradesh lies in the lap of the Himalayas, stretching in an area over 55,673 km^2. The state is administratively divided into 12 districts. Mandi district lies between 31° 13' 30" - 32° 04' 22" North latitudes and 76° 36' 08" - 70° 23' 26" East longitudes. The district is entirely hilly except for some fertile valleys in-between. The district has a total area of 3,950 km^2, which is 7.1% of the total area of the state. The district lies partly on rocks belonging to the Central Himalayan zone of unknown age and partly on tertiary shale and sand stone. The rock formations in Mandi district lie in continuity to those found in the Shimla Himalaya. They can be classified into the sub-Himalayan series of tertiary rocks and the Himalayan series of metamorphosed sedimentary rocks, and the metamorphic--cum-igneous rocks of pre-tertiary age. Mandi district is rich in mineral wealth and is famous since historic times for its salt mines. Limestone is the main raw material for cement besides its other uses such as in the production of lime and steel. Mandi district has forest cover of nearly 39 per cent. Deodar, chil, kail, silver fir, etc. are important species found in the district. The forests are scattered throughout the district on the higher slopes. The most important forests are those lying in the Sutlej valley.

METHODOLOGY

The floristic composition was studied in the mining area. The slope was divided along altitudinal gradients i.e., Hill Top [HT], Middle Hill [MH] and Hill Base [HB], so as to record the flora extensively. The flora of surrounding area was enumerated following primary survey and supplemented with secondary sources. The study on floristic composition in order to assess the biological spectrum was carried out for one year from July, 2008 to June, 2009. Floristic composition was studied following suitable ecological methods. Detailed sampling was done at monthly intervals. The life forms, habit and nature of perennating buds of different plant species were recorded in the field and later confirmed with the help of herbaria. Life form classification was done in accordance that by *Raunkiaers [1934]*, and biological spectrum was compared with normal spectrum. The species were assigned to different life form classes: - Ph: Phanerophytes, Ch- Chamaephytes, Hg- Hemigeophytes: Ge; Geophytes and Th- Therophytes.

RESULTS AND DISCUSSION

A total of 76 species were recorded in the area. These include 22 trees, 18 shrubs, 4 climbers, 6 herbs, 4 grasses, 1 sedge and 3 legumes. Some of the important species includes:- *Acacia, Albizia, Bauhinia, Citrus, Dalbergia, Mallotus, Pinus, Solanum, Rumex, Amaranthus, Datura, Urtica, Woodfordia*, etc. [Table 1]. The survey revealed that most of the trees and shrubs were found at the Hill Base adjoining the village. No trees or shrubs were found to occur in the Middle Hill and Hill Top, except some isolated and scattered shrubs along with some herbaceous flora. As per the field observations, the proposed mining area has very little natural vegetation. In addition, Hill Top and Middle Hill are very steep and are not even amenable to grazing by the local animals. The area does not, in any way, contribute to supplement the sustenance economy or livelihoods of local population due to poor habitat almost bereft with useful vegetation, except limited patches of coarse grasses and scrub vegetation that is extracted as non sustainable fuel. Therefore if mining is allowed to be carried out in this area it will not have any adverse impact on the flora.

LIFE FORM SPECTRUM

[Raunkiaer, 1934], defined life Forms as the sum of the adaptations of plants to climate. According to him:

Phanerophytes: Shrubs and Trees

Therophytes: Annuals including ferns

Hydrophytes: Water plants

Hemigeophytes: Plants with perennial shoots and buds close to the surface

Geophytes: Plants with parenting parts buried in the substratum

Table 1: Occurrence of different species in the mining area

Sr. No.	Botanical name	Families
	TREES	
1.	*Acacia catechu*	Leguminonsae
2.	*Albizia lebbek*	Leguminonsae
3.	*Bauhinia variegata*	
4.	*Bombox ceiba*	Malvaceae
5.	*Cassia fistula*	
6.	*Citrus acida*	Rutaceae
7.	*Cupressus torulosa*	Cupressaceae
8.	*Dalbergia sissoo*	Fabaceae
9.	*Ficus bengalensis*	Moraceae
10.	*Ficus glomerata*	Moraceae
11.	*Ficus religiosa*	Moraceae
12.	*Grewia optiva*	Tiliaceae
13.	*Mallotus philippenensis*	Euphorbiaceae
14.	*Melia azadarach*	Meliaceae
15.	*Morus alba*	Moraceae
16.	*Pinus roxburghii*	Pinaceae
17.	*Punica granatum*	Punicaceae
18.	*Pyrus cummunis*	Rosaceae
19.	*Pyrus pashia*	Rosaceae
20.	*Toona ciliata*	Meliaceae
	SHRUBS	
21.	*Adhatoda vasica*	Acanthaceae
22.	*Artimisia dubia*	Compositae
23.	*Asparagus gracilis*	Liliaceae
24.	*Berberis aristate*	Berberidaceae
25.	*Carissa carandas*	Apocynaceae
26.	*Colebrookia oppositifolia*	Lamiaceae
27.	*Debregeasia hypoleuca*	Urticaceae
28.	*Desmodium gangeticum*	Leguminonsae
29.	*Dioscorea sativa*	Dioscoreaceae
30.	*Dodonea viscosa*	Sapindaceae
31.	*Euphorbia royleana*	Euphorbiaceae
32.	*Lantana indica*	Verbinaceae
33.	*Lespedeza stenocarpa*	Fabaceae
34.	*Murraya koenigii*	Rutaceae
35.	*Plectranthus rugosus*	Labiatae
36.	*Prinsepia utilis*	Rosaceae
37.	*Rabdosia nigosa*	Labiateae
38.	*Rubus ellipticus*	Rosaceae
39.	*Rumex hastatus*	Polygonaceae
40.	*Sapium insigne*	Euphorbiaceae
41.	*Solanum indicum*	Solanaceae
42.	*Thalictrum virgatum*	Ranunculaceae
43.	*Vitex negundo*	Verbenaceae
44.	*Woodfordia fruticosa*	Lythraceae
45.	*Xanthium strumarium*	Asteraceae
46.	*Zizyphus jujuba*	Rhamnaceae
47.	*Zizyphus oxyphylla*	Rhamnaceae
	CLIMBER	
48.	*Cardiospermun halicacabum*	Sapindaceae
49.	*Clematis gouriana*	Ranunculaceae
50.	*Vitis divaricata*	Vitaceae
	HERBS	
51.	*Amaranthus paniculatus*	Amaranthaceae
52.	*Asparagus filicinus*	Asparagaceae
53.	*Aster sp.*	Compositae
54.	*Barleria cristata*	Acanthaceae
55.	*Cannabis indica*	Cannabaceae
56.	*Datura stramonium*	Solanaceae
57.	*Erigeron canadensis*	Compositae
58.	*Erigeron multicaulis*	Compositae
59.	*Euphorbia hirta/royleana*	Euphorbiaceae
60.	*Fragaria indica*	Rosaceae
61.	*Geranium sp.*	Geraniaceae
62.	*Nepeta erecta*	Labiateae
63.	*Polygonum serratulum*	Polygonaceae
64.	*Solanum nigrum*	Solanaceae
65.	*Solanum xanthocarpum*	Solanaceae
66.	*Sonchus asper*	Asteraceae
67.	*Thalictrum spp.*	Ranunculaceae
68.	*Urtica dioica*	Urticaceae
	GRASSES	
69.	*Andropogon distans*	Poaceae
70.	*Cymobopogon martini*	Poaceae
71.	*Cynodon dactylon*	Poaceae
72.	*Dactyloctenium aegyptium*	Poaceae
	SEDGES	
73.	*Fimbristylis dichotoma*	Cyperaceae
	LEGUMES	
74.	*Lathyrus*	Fabaceae
75.	*Trifolium*	Fabaceae
76.	*Trigonella*	Fabaceae

Table 2: List of important pteridophytes found in the area

Sr. No.	Name	Family	English Name	Common Name
1.	*Adiantum capillus*	Adiantaceae	Hairfern	Hansraj
2.	*Adiantum lunulatum*	Adiantaceae	Walkingfern	Gunkeri
3.	*Asplenium pulchera*	Aspleniacea	Spleenwort	
4.	*Asplenum trichomanes*	Aspleniacea	Maiden Hairfern	Maithkondei
5.	*Cheilanthes dalhousie*	Sinopteridaceae	Silverfern	——
6.	*Equisetum*	Equisetaceae	Horsetail	——
7.	*Marselia*	Marsileaceae	Waterfern	Godhi
8.	*Lpteris cretica*	Pteridaceae	————	Jasumba
9.	*Selaginella*	Selaginellaceae	————	——
10.	*Nephrolepis*	Nephrolepidaceae	Swordfern	Banu

Table 3: Comparison of biological spectrum of present site with other regions of the world

Place	Author[s]	No. of Species	Ph.	Ch.	Hg. %	Ge.	Th.	Association
Normal Spectrum	Raunkiaer [1934]	400	46.0	9.0	26.0	6.0	13.0	Ph-Hg
Varanasi	Singh [1969]	-	-	3.1	20.3	7.8	68.7	Th
Kurukshetra	Singh & Yadav [1974]	-	-	10.4	18.7	6.2	62.5	Th.
Pilani	Singh & Joshi [1983]	41	-	17.0	6.0	9.8	68.0	Th
Sagar	Pandey [1964]	-	-	16.3	18.3	18.3	51.0	Th
Behrampur	Mishra & Mishra [1979]	-	5.7	25.7	14.3	5.7	48.6	Th-Ch
Shimla	Kapoor [1987]	28-25	-	14.3	17.9	10.7	57.1	Th
Snowline of Central Himalaya	Rawat & Pangety [1985]	-	-	46.7	30.0	18.3	5.0	Ch-Hg
Alpine region	Santvan & Agrawal [1993]	79	-	29	29.48	32.05	11.53	Ch-Hg
Northwest Himalayas Present work		76	53	-	29	-	18	Ph-Hg

The various species present through out the year were analyzed for different life form classes and percentage distribution among them was computed. The analysis showed that 76 species comprising 40 Ph, 14 Th, and 22 Hg, Ge and Ch were not recorded from the area. The percent values varied as 53% Ph, 18% Th, and 29% Hg. When the present spectrum is compared with normal spectrum in general it was found that phenerophytes, therophytes and hemigeophytes more than the normal spectrum. Geophytes and chamaephytes were completely absent.

The general appearance of a community is caused more by the life-forms of the dominant species than by other characteristics of the vegetation. The proportion of the life forms in an area is a good indicator of its climatic zones *[Misra and Misra, 1979]*. It is believed to have evolved in direct response to the environment. *Singh and Joshi [1983]*, while studying floristic variations for herbaceous vegetation at tropical region of *Pilani and Santvan and Agrawal [1993]*, while studying the alpine vegetation of Northwest Himalayas, also reported the absence of phanerophytes in their respective studies. The presence of appreciably large number of therophytes in an area is often related to drier soil conditions *[Dadhich, 1982]*. *Bharucha and Dave [1944]*, investigated a grassland association of Bombay area dominated by therophytes and observed that it was indicator of the influence of man and animals. *Pandeya [1964]* and *Dayama [1987]*, also observed that overgrazing increases the percentage of Therophytes. The absence of geophytes may be explained by fact that the area is not subjected to adverse climatic conditions. Because, higher percentage of geophytes is an adaptation to with stand long period of adverse climatic condition where storage of food in the form of perenneting organ is an important aspect as has been reported by Santvan & *Agrawal [1993]*, for alpine region of Northwest Himalayan region and by *Rawat and Pangety [1985]*, for snowline vegetation of Central Himalayan [Table :3]. Absence of

Chemophytes in the may be due to biotic stress in the area. Similarly, in earlier study lower number of chemophytes have been reported by *Singh [1969]*, for grassland at Varanasi which have been subjected to biotic disturbance. This explains absence of Chemophytes and geophytes in the area.

CRYPTOGAMIC VEGETATION

The area has several algae, fungi, bryopohytes and pteridophytes. Fungi, particularly from ascomycetes and basidiomycetes, are located on the ground or are epiphytical. Lichenes of crustose and fruticose types were present on different substrates. Bryophytes occur in wet areas and on the bark of trees. The commonly occurring ferns in the area are given in Table 2.

CONCLUSION

The Present study reveal that the phenerophytes and therophytes have higher percentage value when compare to the normal spectrum of *Raunkiaer [1934]*. The geophytes and chamaehytes are absent. The higher number of therophytes may be due to poor soil condition along with biotic interference. The higher number of geophytes is an adaptation to severe climatic condition which is not the case in present study. It can be concluded that in the region not only the climate but the biotic interference has also, changed the life form composition of the area. This is in accordance with the finding of *Warming [1909]*, who emphasized that in the flora of a region great changes are brought about by the biotic pressure. Therefore, Primary strategy of plants in the region remains their survival, resulting in evolution of a wide range of behavioral and life form patterns at species level, under varying biotic disturbance to enable them to occupy various ecological niches in all kinds of climate.

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