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# Vanishing plant wealth of the Valley of Flowers

B.K. Bamola, A.K. Badoni & G.S. Paliwal

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The 'Valley of Flowers'—a National Park, is located in the upper reaches of the Bhyunder Ganga in the far interior of the Garhwal Himalaya. This Alpine Valley, reputed for a variety of blooming plant species, is now facing an abrupt peril of losing its charm, owing to human encroachment in various ways. The present article attempts to describe its vegetation from the phyto-sociological point of view along with the floristics. It is revealed that some of the species reported from this locality during the past 2-3 decades earlier, have been completely eliminated. The greatest danger which the valley is facing stems from the rapidly increasing population of the pernicious weed *Persicaria polystachya*. *Osmunda claytoniana*, a tall fern, is also spreading very fast and in due course will definitely prove yet another hazard. It is alarming to note that the 'Himalayan Blue Poppy' (*Meconopsis aculeata*) for which the valley has been so famous, can hardly be seen now. Our list includes 330 plant species encountered in this area, along with a separate enumeration of plant species which have become rare. Some suggestions have been offered towards restoring the grandeur of this beautiful abode of Nature.

**Key-words**— Taxonomy, Angiosperms, Phyto-sociology.

B.K. Bamola, A.K. Badoni & G.S. Paliwal, *Developmental Botany Laboratory, Department of Botany, H.N.B. Garhwal University, Srinagar 246 174 (Puri, U.P.), India.*

## सारांश

### पुष्पों की घाटी से विलुप्त होते पौधे

बी.के. बमोला, ए.के. बडोनी एवं जी.एस. पालीवाल

'पुष्प घाटी' गढ़वाल हिमालय में भिर्युंदर गंगा के ऊपरी भाग में स्थित है। इस अल्पीय घाटी, जो कि अत्यन्त चटकीले पुष्पों के लिए विख्यात है, की अब शनैःशनैः अपनी सुन्दरता कई कारणों से कम होती जा रही है। प्रस्तुत शोध-पत्र में वनस्पतिजातीय एवं पादप-सामाजिक दृष्टिकोण को ध्यान में रखते हुए इस घाटी की वनस्पति वर्णित करने का प्रयास किया गया है। यह प्रेक्षित किया गया है कि पिछले दो-तीन दशकों में इस घाटी से अभिलिखित पादप जातियों में से कुछ जाति बिल्कुल विलुप्त हो गई हैं। इस घाटी के पौधों को सबसे अधिक खतरा इस समय *पर्सिकेरिया पोलिस्टेकिया* नामक पौधे के बढ़ते अतिक्रमण से है। इसके अतिरिक्त *ओस्मुन्डा क्लेटोनियाना*, जो एक उन्ना फर्न है, नामक फर्न भी बड़ी तेजी से फैलता जा रहा है। यह भी चिन्ताजनक है कि हिमालयी नीली पोपी — *मीकोनाप्सिस एक्यूलिआटा*, अब घाटी में बहुत कम दिखाई पड़ती है। इस पौधे के लिए यह घाटी प्रसिद्ध थी। हमारी सूची में इस घाटी में मिलने वाले पौधों की 330 जातियाँ हैं। इसके अतिरिक्त इस घाटी की सुन्दरता को पूर्ववत रखने के लिए कुछ सुझाव भी प्रस्तावित किये गये हैं।

THE 'Valley of Flowers' is a high altitude National Park, situated between lat. 79°35' - 79°40'N and long. 30°40' - 30°45'E in the upper reaches of the Bhyunder Ganga, in the far interior region of the Garhwal Himalayas, lying in the Zanskar ranges, an off-shoot of the great Himalayan ranges. It was established on November 6, 1982. Although previously known amongst the natives as the Bhyunder Valley, this famous Alpine Valley owes its present name and international reputation due to the efforts and enthusiasm of the British mountaineers, especially R.L. Holdsworth and Frank Symthe who discovered it accidentally while they were returning from their successful ascent of Kamet (7,756 m), in the Zanskar Himalayas in the year 1931.

Nestling in the shadow of the glittering snow-clad peaks, the valley is adored with several clear running streams, their banks covered with lush-green vegetation. The splendour of the valley has been drawing the attention of the naturalists and travel enthusiasts from far and wide. In the words of Frank Smythe:

"In all my mountain wanderings, I have not seen a more beautiful flower than this *Primula*; the fine rain-drops clung to its soft petals like galaxies of seed pearls and frosted its leaves with silver. Lower, where we camped near a moraine were *Androsaces*, *Saxifrages*, *Sedums*, yellow and red *Potentillas*, *Geums*, *Geraniums*, *Asters*, *Gentians*, to mention but a few plants, and it was impossible to take a step without crushing a flower. Next

day we descended to lush meadows. Here our camp was embowered amidst flowers, snow-white drifts of Anemones, golden lily-like *Nomocharis*, Marigolds, Globe flowers, Delphiniums, Violets, *Eriotrichiums*, Blue *Corydalis*, wild roses, flowering shrubs, and rhododendrons, many of these flowers with homely sounding English names. The Bhyunder Valley was the most beautiful valley that any one of us has seen... others will visit it, analyse it and probe it but, whatever their opinions, to me it will remain the Valley of Flowers, a valley of peace and perfect beauty where the human spirit may find repose".

The area is approachable from Govindghat, its nearest road-head which is 295 km away from Haridwar, on the Haridwar-Badrinath road. After crossing the Alaknanda River at Govindghat, an ascending bridal path along the Bhyunder Ganga leads to Ghangaria, 12.5 km from Govindghat, from where the valley is only 25 km away. The entire area comprises steep mountains and slopes except the locale along the Pushawati River where there is a moderately flat area of about 5 km in length and 1 to 2 km in width. The valley proper extends in NE-SW direction but from the temporary wooden bridge on the Pushawati River to Bhamni-Dhar, the valley is spread in the N-S direction.

Geologically, this region falls into the central crystalline rocks which are of granite composition. The main valley has been formed due to the receding of the main glacier Tipera Kharak. Lateral moraines exhibit luxuriant growth of *Betula utilis*. The rock-falls, debris-falls, and old-slides, generally of scree deposits, are also common there. The Pushawati River shifts the slope angles of the lateral moraines due to which a position of slope-instability is created. The slope conditions are of cliff type. Prominent joint systems of the sets are commonly observed in the granite rocks.

The valley continues to be in bloom for nearly three complete months although its floral composition keeps on changing, every few days. Blooming is initiated immediately after the snow starts melting and the peak flowering season is witnessed from about the middle of July to the middle of August. By September, the hue starts changing and the onset of autumn bids farewell to the flowers. The entire vegetation perennates for next about five months, when the valley becomes completely snow-bound.

## THE PRESENT STATE AND CAUSE OF CONCERN

As mentioned earlier, this world-famous valley has been a paradise for the lovers of Nature since long. However, during the past couple of decades or so, due to these opening of the new routes and roads, and consequently better transport facilities, there has been an increased influx of the visitors. Besides, due to several other factors listed in this communication, the ecological balance of the valley has been adversely influenced. There is a noticeable deterioration in the ecosystem and it is now fast losing its charm and attraction. A visitor now generally returns with a feeling of despair and is in fact unable to visualize the beauty once exhibited by it. In order to restore the ecosystem and also to preserve the valuable heritage for posterity, the valley proper together with its surroundings have been constituted into a national park, named as "The Valley of Flowers National Park", on November 6, 1982. In spite of these efforts put in by the Government authorities, there has been no significant improvement thus far, owing to the lack of proper scientific analysis.

A survey of the literature reveals that the collection, enumeration, and recording of the plant species from the valley has been attempted by several workers including Smythe (1938), Ghildyal (1957), Rau (1964) and Naithani (1984). Their publications mainly emphasize the taxonomic aspects, and the ecological approach, particularly the phyto-sociological analysis, has hardly received the attention, it deserves. The present study has been undertaken to understand the vegetation composition vis-a-vis the earlier records, relating to the environment and other factors and to frame out some suggestions which could be helpful in maintaining and improving the ecological balance.

Our ideas are based on the analysis of our repeated visits here during the span of two years (1986-1992), from June to middle of October. In order to prepare a list of the plants present in the valley, a herbarium has been prepared, with the representative collection available, and the plants identified after comparing these with the specimens present at the Garhwal University Herbarium (GHU), Forest Research Institute Herbarium (DD), and the herbarium of the Northern Circle of the Botanical Survey of India, Dehradun (BSD).

The vegetation has been analysed from phyto-sociological viewpoint. The belt transect method (Oost-

ing, 1958) was adopted for sampling. The belt was reckoned 10 m for the first half km where the vegetation is dominated by trees and Alpine bushes. For the rest of the valley, it was 1 m wide since the vegetation is chiefly herbaceous. A distance of 250 m was maintained between each belt. The belts extended in length from the bank of the Pushpawati River to the point where the steep slopes end. Besides, the quadrat (0.50 x 0.50m) method was also followed in the areas where extensive patches of *Persicaria polystachya* are seen. Simultaneously, the data for temperature and relative humidity have also been recorded on each visit.

## RESULTS AND DISCUSSION

In our opinion the starting point of the valley is a spot about 2 km off Ghangaria. For the present study, the temporary wooden bridge on the Pushpawati River has been considered as the starting point. From this place up to half a km, there is an area largely occupied by the tree species, growing on the steep slopes. The dominant species are: *Abies pindrow* and *Betula utilis*. Along with these, *Michelia kiposa* and *Sorbus cuspidata* are also distributed randomly. The climber *Hedera nepalensis*, in the form of a woody liana, is seen growing atop most of the fir trees. Leaving aside this area, one finds that the rest of the valley has predominantly herbaceous vegetation with scattered bushes. Almost these *Rhododendron campanulatum* and *R. lapidotum* are really remarkable for their beauty. The other Alpine bushes found rather commonly include: *Acer cappadocicum*, *Cotoneaster acuminata*, *C. obtusa*, *Hippophae rhamnoides*, *Juniperus communis*, *J. indica*, *J. squamata*, *Lonicera obova*, *L. purpurescens*, *Myricaria bracteata*, *Rhus acuminata*, *R. punjabensis*, *Ribes glaciale*, *R. himalense*, *Rubus foliolosus*, *Salix fruticosa*, *S. karelinii*, *S. lindleyana*, *Sorbus ursina*, and *Spiraea canescens*.

Among the herbaceous forms, *P. polystachya* is the most common species and its spread is in the largest part of the valley. This is followed by *Allium*, *Anaphalis*, *Anemone*, *Bistorta*, *Caltha*, *Campanula*, *Corydalis*, *Galium*, *Gentiana*, *Heracleum*, *Impatiens*, *Ligularia*, *Morina*, *Oenothera*, *Oxyria*, *Pedicularis*, *Phomis*, *Potentilla*, *Ranunculus*, *Senecio*, *Saussurea*, *Selinum*, and *Thalictrum*, etc.

Following is the list of plants covering trees, bushes and herbs, that have been recorded from the valley:

- Abies pindrow* Royle
- Acer cappadocicum* Gledt.
- Acomastylis eleta* (Wall. ex Royle) F. Bolle
- Aconitum atrox* (Bruhl.) Mukherjee
- A. violaceum* Jacq. ex Stapf.
- Aconogonum rumicifolium* (Royle ex Bab.) Hara
- Agrostis munroana* Ait. ex Hemsl.
- A. pilosula* Trin.
- Aletris peuciflora* (Klotz.) Hand. Maz.
- Allium humile* Kunth
- A. wallichii* Kunth
- Anagalis busua* (Buch.-Ham. ex D. Don) DC.
- A. contorta* (D. Don) Hook. f.
- Androsace chamaejasme* Hort.
- A. sarmentosa* Wall.
- Anaphalis cuneifolia* (DC.)
- A. vitifolia* Buch.-Ham. ex DC.
- Angelica archangelica* L.
- A. glauca* Edgew.
- Anthriscus namorosa* Spreng.
- Arabis amplexicaulis* Edgew.
- A. bijuga* Watt.
- A. nova* Vill.
- Arenaria ciliolata* Edgew.
- A. glanduliflora* Edgew. ex Edgew. & Hook. f.
- A. orbiculata* Royle ex Edgew.
- A. perlevis* (Will.) Hand.-Maz.
- Arisaema jacquemontii* Bl.
- A. propinguum* Schott.
- Artemisia nilagirica* (Cl.) Pamp.
- A. roxburghiana* Bassev.
- Aster diplostephioides* (DC.) Cl.
- Astilbe rivularis* Buch.-Ham. ex D. Don
- Astragalus cendolleanus* Royle ex Benth.
- A. chlorostachys* Lindl.
- A. himalayanus* Klotz.
- Bergenia stracheyi* (Hook. f. & Thoms. Engl.)
- Berberis umbellata* Wall. ex D. Don
- Betula utilis* D. Don
- Bistorta affine* (D. Don) Greene
- B. amplexicaulis* (D. Don) Greene
- B. vacciniifolia* (Wall. ex Massn.) Greene
- B. vivipara* (L.) S.F. Grey
- Boeninghausenia albiflora* (Hook.) Meissn.



**Parasite**

*Boschaniackia himalaica* Hook. & Thoms.

**Tall herbs**

*Brachyactis anomalium* (DC.) Kitamurg  
*B. pubescens* (DC.) Ait. & Cl.  
*Briza media* L.  
*Bupleurum falcatum* L. var. *marginatum*  
 Wall. ex DC.) Cl.  
*B. hamiltonii* Balak.  
*B. himalayense* Klotz.  
*Calamagrostis emodensis* Griseb.  
*Callianthemum pimpinelloides* (D. Don)  
 Hook. f. & Thoms.  
*Caltha palustris* L.  
*Campanula aristata* Wall.  
*C. colorata* Wall.  
*C. latifolia* L.  
*C. modesta* Hook. f. Thoms.  
*Campylotropis ariocarpa* (Maxim.) Schindr.  
*Caragana brevispina* Royle  
*Carex nivalis* Boot.  
*C. nubigena* D. Don.  
*Cassiope fastigiata* (Wall.) D. Don  
*Cephalanthera longifolia* (L.) Fritsch.  
*Chaerophyllum nubigenum* (DC.) Hand-Maz.  
*Cicerbita cyanea* (D. Don) Beauv.  
*C. lessertiana* DC.  
*C. macrorhiza* (Royle) Beauv.  
*Circaeaster agrestis* Maxim  
*Circaea alpina* L. subsp. *imaicola* (Aschen. et  
 Magn.) Kitam.  
*Clematis barbellata* Edgew.  
*C. buchananiana* DC.  
*C. connata* DC.  
*C. grata* Wall.  
*Clinopodium umbrosum* (M. Bieb.) Moch.  
*C. vulgare* L.  
*Clintonia udensis* Trautv. & Mey  
*Codonopsis viridis* Wall.  
*Cortia depressa* (Don) Norman  
*Corydalis cornuta* Royle  
*C. cashmeriana* Royle  
*Cotoneaster acuminata* Lindl.  
*Cucubalus baccifer* L.  
*Cyathula tomentosa* (Roth.) Mag.  
*C. microphyllus* Edgew.

*Cypripedicum cordigerum* D. Don  
*Corydalis longipes* DC.

**Herbs**

*Dactylorhiza hatagirea* (D. Don) Soo Nom.  
*Denthonea jacquemontii* Bor  
*Desmodium elegans* DC.  
*Deyeuxia pulchella* (Griseb.) Hook. f.  
*Drabe pracillima* Hook. f. & Thoms.  
*D. lasiophylla* Royle  
*Dubyaea hispida* DC.  
*Elsholtzia ciliata* (Thunb.) Hylender  
*E. fruticosa* (D. Don) Rehder  
*Epilobium cylindricum* D. Don  
*E. lasiophyllum* Hausskn.  
*E. latifolium* L.  
*E. paluspe* L.  
*Epipactis helleborine* (L.) Crantz.  
*Epipogium aphyllum* (Scn.) Sw.  
*E. roseum* (D. Don) Lindl.  
*Erigeron alpinus* L.  
*E. multiradiatus* (Lindl. ex DC.) Cl.  
*Erysimum hieraciifolium* L.  
*Euphorbia pilosa* L.  
*Euonymus fimbriatus* Wall.  
*E. hamiltonianus* Wall.  
*Fallopia convolvulus* (L.) Holub.  
*Fastuca gigantea* (L.) Vill.  
*E. polycolia* Stapf.  
*Fragaria nubicola* Lindl. ex Lacaite  
*Fritillaria cirrhosa* D. Don  
*F. roylei* Hook.  
*Galium acutum* Edgew.  
*G. aparine* L.  
*G. asperifolium* Wall.  
*Gaultheria trichophylla* Royle  
*Gentiana aquatica* L.  
*G. argentea* (D. Don) Cl.  
*G. controta* Royle  
*G. stipitata* Edgew.  
*G. tubiflora* (G. Don) Griseb.  
*G. venusta* (G. Don) Griseb.  
*Gentianella pedunculata* (D. Don) H. Sm.  
*Geranium collinum* Stepf. ex Willd.  
*G. himalayense* Klotz.  
*G. lamnerti* Sw.  
*G. nepalense* Sw.

- G. pratense* L.  
*G. robertianum* L.  
*G. wallichianum* D. Don ex Sw.  
*Gerbera pusilla* (Wall. ex DC.) Goel et  
 Bhattacharya  
*Geum roylei* Bolla  
*Gonostegia bhirta* (Bl.) Miq.  
*Goodyera fusca* (Lindl.) Hook. f.  
*G. repens* (L.) R.Br.  
*Habenaria latilabris* (Lindl.) Hook.f.  
*Hedera nepalensis* Koch.  
*Hierochola laxa* R.Br. ex Hook.f.  
*Hippophae rhamnoides* Serv.  
*Hypericum elodeoides* Choisy  
*H. hookerianum* Wt. & Arn.  
*Inula grandiflorum* Willd.  
*Impatiens amplexicaulis* Edgew.  
*I. bicornuta* Wall.  
*I. glandulifera* Royle  
*I. racemosa* DC.  
*I. sulcata* Wall.  
*Jasminum humile* L.  
*Juncus himalensis* Klotz.  
*Juniperus communis* L. var. *sexatilis* Pallas  
*J. indica* Bertol  
*J. squamata* Buch.-Ham.  
*Koenigia nepalensis* D. Don  
*Lamium album* L.  
*Lecanthus peduncularis* (Royle) Wedds.  
*Leontopodium himalayanum* DC.  
*Ligularia amplexicaulis* DC.  
*L. arnicoides* DC.  
*Listera longifaulis* King & Pant  
*Lomatogonium carinthiacum* (Wulf.) Reichenb.  
*Lonicera odorata* Royle ex Hook. f. & Thoms.  
*L. purpurescens* Walp.  
*Luzula multiflora* (Retz.) Lej.  
*Malaxis muscifera* (Lindl.) Kuntz.  
*Malva verticillata* L.  
*Mecanopsis aculeata* Royle  
*Megacarpaea polyandra* Benth.  
*Michelia kiposa* Buch.-Ham. ex DC.  
*Morina longifolia* Wall. ex DC.  
*Muhlenbergia himalayensis* Hook. ex Hook. f.  
*Myriactis nepalensis* Less.  
*Myricaria bracteata* Royle  
*Neottia listeroides* Lindl.  
*Nepeta goveniana* (Benth.) Benth.  
*N. laevigata* (D. Don) Hand.-Maz.  
*Oreorchis indica* (Lindl.) Hook. f.  
*Oreorchis micrantha* Lindl.  
*Origanum vulgare* L.  
*Osmunda claytoniana*  
*Osmorrhiza aristata* (Thunb.) Royle  
*Oxyria digyna* (L.) Hill  
*Parietane micrantha* Ledeb  
*Parnassia rubicola* Wall. ex Royle  
*Parochetus communis* Buch-Ham. ex D. Don  
*Pedicularis bicornuta* Klotz.  
*P. bifida* (Buch.-Ham. ex D. Don) Pannell  
*P. gracilis* Wall. ex Benth.  
*P. hoffmeisteri* Klotz.  
*P. oderi* Vehl.  
*P. pectinata* Wall. ex Benth.  
*Persicaria polystachya* (Wall. ex Meissn.)  
 Gross.  
*Phelum alpinum* L.  
*Phlomis bracteosa* Royle ex Benth.  
*Picrorhiza scrophulariflora* Pennell  
*Pilea racemosa* (Royle) Tuyama  
*Pimpinella diversifolia* DC.  
*Plectranthus japonicus* (Burm. f.) Koidzuma  
*P. meddeni* Benth. ex Hook. f.  
*P. rugosus* Wall. ex Benth.  
*Pleurospermum angelicoides* (DC.) Cl.  
*P. densiflorum* (Lindl.) Cl.  
*Poa pagophila* Bor.  
*P. supina* Schrad.  
*Podophyllum hexandrum* Royle  
*Polemonium caeruleum* subsp. *himalayanum*  
 (Backer) Hara  
*Polygala crotolarioides* Buch.-Ham. ex DC.  
*Polygonatum graminifolium* Hook.  
*Potentialla argyrophylla* Wall. ex Lehm.  
*P. artrosanguinea* Lodd.  
*P. biflora* Willd. ex Schlecht  
*P. ariocarpa* Wall. ex Lehm.  
*P. fruticosa* L. var. *pumila* Hook. f.  
*P. fulgens* Wall. ex Hook.  
*P. gelida* C.A. Mey  
*P. lescheneultiana* Set.  
*Potentilla leuconeta* D. Don  
*P. polyphylla* Wall. ex Lehm.  
*Prenanthes brunaniana* Wall. ex DC.

- Primula denticulata* Sm.  
*P. elliptica* Royle  
*P. macrophylla* D. Don  
*P. reidii* Duthie  
*Prunus cornuta* (Wall. ex Royle) Seud.  
*Ranunculus hirtellis* Royle ex D. Don  
*Rheum moorcroftianum* Royle  
*R. webbianum* Royle  
*Rhodiola bupleuroides* Wall. (ex Hook. f. & Thoms.) Fu.  
*R. crenulata* (Hook. f. & Thoms.) Ohba  
*R. heterodonta* (Hook. f. & Thoms.) A. Boris  
*R. imbricatum* (Edges.) Welpers  
*R. quadrifidum* Pall.  
*R. sinueta* (Royle ex Edgew.) Fu.  
*R. wallichiana* (Hook.) Fu  
*Rhododendron campanulatum* D. Don  
*R. lapidotum* Wall. ex G. Don  
*Rhus acuminata* DC.  
*R. punjabensis* Stewart  
*Ribes glaciale* Wall.  
*R. himalense* Royle ex Dcne.  
*Rosa macrophylla* Lindl.  
*Rosularia rosulata* (Edgew.) H. Ohba  
*Rubus foliolosus* D. Don  
*Sagina saginoides* (L.) Karaten.  
*Salix fruticosa* Anders.  
*S. karelinii* Tutcz.  
*S. lindleyana* Wall. ex Anders.  
*Salvia nubicola* Wall. ex Sw.  
*Sanguisorba diandra* (Hook. f.) Nordberg  
*Satyrium nepalense* D. Don  
*Saxifraga asarifolia* Sternb.  
*S. diversifolia* Wall. ex Sering  
*S. hirculus* L.  
*Saxifraga filicaulis* Wall. ex Sering  
*S. taroxifolia* Wall. ex DC.  
*S. Jacquemontiana* Dcne.  
*S. pernessifolia* D. Don  
*S. pulvinaria* H. Smith  
*S. stenophylla* Royle  
*Saussurea albescens* (DC.) Sch. Bip.  
*S. auriculata* (DC.) Sch. Bip.  
*S. fasticosa* (DC.) Sch.-Bip.  
*S. gnaphaloides* (Royle ex DC.) Sch. Bip.  
*Saussurea leontodontoides* (DC.)  
*S. piptathera* Edgew.  
*Scrophularia edgeworthii* Benth.  
*Sedum linearifolium* Royle  
*S. orcedes* (Dcne.) Homet.  
*S. tibeticum* Hook. f. & Thoms. var. *stracheyi* Hook. f. & Thoms.  
*S. trullipetalum* Hook. f. & Thoms.  
*Selinum elatum* (Edgew.) Hiroe  
*S. vaginatum* (Edgew.) Cl.  
*S. wallichianum* (DC.) Raizada ex Saxena  
*Senecio chrysanthemoides* DC.  
*S. diversifolius* Wall. ex DC.  
*S. grandiflorus* DC.  
*S. kunthianus* Wall. ex DC.  
*S. rufinervis* DC.  
*Sempervivum mucronatum* Edgew.  
*Sibbaldia parviflora* Willd.  
*Silene edgeworthii* Bocquet  
*S. felconeriana* Benth.  
*S. indica* Roxb. ex Otth.  
*Solidago virga-aurea* L.  
*Sorbus cuspidata* (Spach.) Hedland  
*Spiraea canescens* D. Don  
*Stachys sericea* Wall. ex Benth.  
*Stellaria alsine* Grimm.  
*S. documbens* Edgew.  
*S. onosperma* Buch.-Ham. ex D. Don  
*Stipa roylei* (Nees) Mez.  
*Strobilanthes atropurpureus* Nees.  
*Swertia alata* (Royle ex D. Don) Cl.  
*S. speciosa* D. Don  
*S. tetragona* Edgew.  
*Syringa emodi* Wall. ex Royle  
*Thalictrum alpinum* L.  
*T. chelidonii* DC.  
*T. elegans* Wall. ex Royle  
*T. panciflorum* Royle  
*T. reniforme* Wall.  
*T. saniculaeforme* DC.  
*Thermopsis barbata* Royle  
*Thymus linearis* Benth.  
*Torilis japonica* (Hovtt.) DC.  
*Trifolium repens* L.  
*Trigonella corniculata* L.  
*T. emodi* Benth.  
*Trillidium govonianum* (D. Don) Kunth.  
*Tripterospermum volubile* (D. Don) Hara  
*Triserum aeneum* (Hook. f.) R.R. Steward

*T. spicatum* Bor.  
*Trollius acaulis* Lindl.  
*Urtica ardens* Link.  
*Virburnum grandiflorum* Wall. ex DC.  
*Verbascum thapsus* L.  
*Veronica umbelliformis* Pennell.  
*V. himalensis* D. Don  
*Vicatis coniifolia* DC.  
*Viola biflora* DC.  
*V. pilosa* Bl.  
*Waldheimia glabra* (Dcne.) Regl.

It is quite alarming to note that some of the species reported 2-5 decades ago from here have either totally vanished or are at the verge of disappearance for they are now seen growing rarely. It may just sound unbelievable that the Himalaya Blue Poppy" (*Meconopsis aculeata*), for which the valley has been so famous, can hardly be traced now. Following is the list of plants which have either disappeared or are encountered only rarely:

*Aconitum atrox* (Bruhl.) Mukherjee  
*Allium himile* Kunth.  
*A. wallichii* Kunth.  
*Anthriscus nemorosa* Spreng.  
*Arnebia euchroma* (Royle) I.M. Johnston  
*Circaeaster agrestis* Maxim.  
*Didicys cunninghamii* King & Pant.  
*Drabe lasiophylla* Royle  
*Erysimum lambertii* Sw.  
*Gemanthodium decaisnei* Cl.  
*Hypericum hookerianum* Wt. & Arn.  
*Lloydia tribetica* Baker ex Oliver  
*Megacarpa polyandra* Benth.  
*Minuartia kashmirica* (Edgew.) Matt.  
*Morina wallichii* Royle  
*Nardostachys grandiflora* DC.  
*Kobresia laxa* Nees.  
*Pedicularis bicornuta* Klotz.  
*P. oderii* Vahl.  
*P. roylei* Maxim.  
*Picrorhiza scrophulariflora* Pennell  
*Podophyllum hexandrum* Royle  
*Polygonium hookeri* Baker  
*Potentilla biflora* Willd. ex Schlecht.  
*Primula hydei* Watt.  
*P. minutissima* Jacq. ex Dubby  
*P. kotundifolia* Wall.  
*P. wigramiana* W.W. Sm.

*Saussurea obvallata* (DC.) Edgew.  
*Swertia angustifolia* var. *pulchella* Burkill  
*Turritis glabra* L.  
*Veronica umbelliformis* Pennell  
*V. himalensis* D. Don  
*Waldheimia glabra* (Dcne.) Regl.  
*W. tomentosa* (Dcne.) Regl.

Shifting our attention towards the abundance of *P. polystachya*, a notorious weed in this valley, it must be emphasized that this is going to be the chief threat to the ecological balance considering the valley as a whole. This weed has covered nearly 39 per cent of the area and its relative dominance is about 47 per cent. These figures are indeed extremely staggering. Considering the steeper slopes of the valley only, we find that the frequency of this weed reaches as high as 85 per cent. If an immediate check is not imposed, this weed may cover most of the valley within a couple of years. This presumption is substantiated from the fact that this plant propagates through rhizomes as well as the seeds and its seed output is enormous. Furthermore, it not only reaches considerable heights 2-3 m above the ground, the underground growth is even more vigorous. Besides it, only a few scattered specimens of the herbaceous plants such as *Impatiens*, *Galium*, *Geranium*, *Parnessia*, *Pedicularis*, *Senecio*, etc. can be seen.

Not only this, but *Osmunda claytoniana*, a fern, has also occupied the area in dense patches throughout the valley and is in fact next only to *P. polystachya* in dominance. This is followed by *Impatiens gigantia* and *I. gladiifera sulcata*, remarkable species. A point worthy of note is that the frequency and dominance of these two species calculated during 1987 is higher than those during the previous year. This is suggestive of the fact that these two plants may also prove to be hazardous to other significant herbs in the valley.

Apart from the danger from the notorious weeds and the biotic pressure in the form of disturbances caused by the visitors, yet another important factor responsible for the deterioration of the floral diversity is the complete ban on grazing imposed by the Forest Department since 1982. Although it is true that the first cause for the degradation of the ecosystem of this valley is beyond doubt heavy grazing but the fact is that the complete ban has also contributed in the same direction is also to be noted. This should be dug along the steep slopes, since it is most abundant on these sites.



Controlled sheep grazing should be permitted in the valley instead of (free) open grazing or a complete ban on this practice. This may be practised in the following manner:

At the onset of the growing season, when snow starts melting, the cattle should be allowed to graze freely in the valley for 20-30 days. Subsequently these should be shifted to the Tipra Kharak Glacier. Here the ice melts a little later and thus by this time the conditions correspond just to those in the valley, 20-30 days before. After letting the cattle to graze in this area for about 3 to 4 weeks, they should be further moved to the Ratanban areas or the Lakshman Pass. Having remained there for two to two and a half months, the cattle should be allowed to return through the same route. In this way, the valley proper will experience grazing only during the onset and the end of the growing season. *P. polystachya* is amongst the species, emerging just at the start of the growing season of the herbs, right when snow melting gets initiated, a considerable number of young off-shoots and seedlings of this weed are likely to be damaged or consumed by the cattle. Most of the flowering plants are seen to germinate a little later in this valley. Furthermore, during the end of the season, most of the species complete their life-cycle and start perennation and thus there will be very little harm, if any, to these forms.

Since the leaves of *P. polystachya* are fondly consumed by the horses, the local horse-owners, who carry the visitors to the Hemkund, should be encouraged to cut off this weed to be used as a forage. Assumption is further proved by the comparison of the vegetation of the adjacent areas which are frequently grazed. Instance-wise, the area between Ghangharia and Hemkund is very rich in floral diversity and several of the species which are absent from the valley or are represented there only by a few specimens, are flourishing on the way to Hemkund in good numbers. We have ventured to offer suggestions to remedy this problems in the subsequent paragraphs.

Besides, the geological catastrophes are also contributing to the depletion of the vegetation from this valley. The landslides or the rock-falls block the route of the river and small rivulets in the valley rather frequently. This causes flash-floods which erode the top soil heavily, alongwith which the shallow-rooted herbs and seeds are washed away.

### MEASURES SUGGESTED FOR RESTORING THE VEGETATION

After the establishment of the Valley of Flowers National Park, the Government has started looking this area from conservation point of view and attempts are indeed being made by the Forest Department in this direction but still no apparent results could be observed. The following remedial measures are being suggested by the authors to prevent further deterioration :

1. A strict check should be implemented on the visitors so that the ecosystem faces least biotic pressure.
2. Young inflorescences of *P. polystachya* should be pruned down well before anthesis to check the dispersal of this weed through seeds.
3. To check the spread of *P. polystachya* through the deep seated root system and the underground rhizomes, 2 m deep trenches.
4. A labour-force should be constantly maintained in the valley area proper to remove the rocks fallen and the debris, over the river and the rivulets expeditiously, so that there are least chances of flash-floods.

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