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RESEARCH ARTICLE

Assessment of plant diversity for threat elements: A case study of Nargu wildlife sanctuary, north western Himalaya

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Abstract: Biodiversity crisis is being experienced throughout the world, due to various anthropogenic and natural factors. Therefore, it is essential to identify suitable conservation priorities in biodiversity rich areas. For this myriads of conservational approaches are being implemented in various ecosystems across the globe. The present study has been conducted because of the dearth of the location-specific studies in the Indian Himalayas for assessing the 'threatened species'. The threat assessment of plant species in the Nargu Wildlife Sanctuary (NWS) of the northwest Himalaya was investigated using Conservation Priority Index (CPI) during the present study. CPI was calculated using cumulative values of various qualitative and quantitative attributes *viz*., habitat specificity, population size, distribution range, use values, extraction, nativity and endemism of the taxa. Out of a total of 733 species recorded in the area, 102 species (20 Trees; 14 Shrubs; and 68 Herbs) belonging to 82 genera and 54 families were identified as threatened. The study revealed that 8 species 'Critically Endangered', 17 species 'Endangered' and 77 species 'Vulnerable'. These species must be monitored and actively managed with appropriate conservation strategies including periodical assessment of populations using standard ecological methods in order to conserve the high biodiversity in the NWS.

Keywords: Conservation, endemism, Himalaya, nativity, threatened.

INTRODUCTION

Biodiversity is one of the major livelihood options as it provides many ecosystem services including provisioning, regulating, supporting and cultural (MA, 2005). Several elements of biodiversity (e.g. species, habitats and ecosystem services) are in decline as the human domination of the earth continues to increase (Groombridge and Jenkins, 2000; Hilton-Taylor, 2000; GEO3, 2002). Major threats to ecosystems and biodiversity are habitat fragmentation and its losses, over exploitation, invasions of non-native species, global climate change (IUCN, 2003) and disruption of community structure (Novasek and Cleland, 2001). As a result of the anthropogenic pressure, the plant extinction rate has reached to137 species per day (Mora *et al.*, 2011; Tali *et al.*, 2015). At present, the rapid loss of species is estimated to be between 1,000–10,000 times faster than the expected natural extinction rate (Hilton-Taylor, 2000). Under the current scenario, about 20% of all species are likely to go extinct within next 30 years and more than 50% by the end of 21st century (Myers, 1993). The most direct measure of the threats to the biodiversity can be derived from the assessments of conservation status of the species. The IUCN Red List of Threatened Species, categorize species that have a high probability of extinction in the future as 'Critically Endangered', 'Endangered' or 'Vulnerable'. The degradation and fragmentation of >70% of the original habitats have placed Himalaya in the list of Global Biodiversity Hotspots, where only 25% of the original habitats are remaining unaffected due to various natural and anthropogenic pressures (Mittermeier *et al.*, 2004). The Convention on Biological Diversity Summit (June, 1992) signaled the global recognition of the alarming loss of biodiversity. Since then, various studies have been conducted to explore and identify the threatened plants of the world (Singh, 2002). As far as the matter of assigning the threat status to a species is concerned, a species' global conservation status, is not necessarily the same as the conservation status on a regional scale. However, it is often argued that status of a particular species may vary from region to region, thus local needs and threats should also be considered while deciding conservation priorities (Silva and Albuquerque, 2005; Gauthier *et al.*, 2010). Some species that

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are threatened on the global scale may not be threatened at a regional scale, and species that are not threatened on a global scale might be threatened in some parts of their range (Gardenfors *et al.*, 2001). Moreover, knowing the regional status of species is important as the loss of population and genetic diversity has become a major concern in the present scenario (Grammont and Cuaron, 2006). When a species is protected at the regional level, conservation of its genetic diversity is promoted (Hunter and Hutchinson, 1994). Regional scale extinction of one species can trigger a cascade of extinctions, causing a change in species structure, composition and in ecosystems processes (Lundberg *et al.*, 2000). This deviation in the threat status from region to region clearly suggests that local situation must be taken into account while setting conservation priorities. Therefore, growing awareness on the importance and high rates of loss biodiversity make it imperative to rapidly assess and conserve biodiversity, both at regional and global levels. Since IUCN categorization only is not sufficient for formulating the local and regional conservation strategies as usually it has a larger area under its influence. Hence, there is need of collecting and maintaining precise and accurate information that can be used for the area specific prioritization of species. Many researchers have studied the threatened plants in Indian Himalayan Region (IHR) (Pangtey and Samant, 1988; Samant *et al.*,1998; Pandey and Well, 1997; Kala *et al.*, 1998; Dar and Naqshi, 2001; Badola and Pal, 2003; Ved *et al.*, 2003; Rana and Samant, 2010; Banerji and Basu, 2011; Goraya *et al.*, 2013 and Tali *et al.*, 2015). Various studies have been carried out in the protected and unprotected areas of Himachal Pradesh (Lal, 2007; Rana and Samant, 2010; Sharma, 2013).

Although, there has been an increasing recognition of the significance of the wider landscape and community conservation approaches, the central role of protected areas in conservation is still widely recognized (Monzón *et al.*, 2011; Zomer *et al.*, 2015). Only a few studies have been carried out in the protected areas using different attributes of rarity *i.e*., habitat preference, population size, nativity/ endemism, anthropogenic pressure and distribution range (Rawal and Dhar, 1997; Samant, 1999; Joshi and Samant, 2004; Kala, 2004; Samant and Joshi, 2005;Lal, 2007; Rana and Samant, 2010, *etc*.). Although located on the northwestern slopes of Himalaya the threat assessment of all the species of Nargu Wildlife Sanctuary has not been carried out so far. Therefore, the present studyattempts to assess the threat categories of species, study their distribution pattern and suggest conservation options considering the results.

MATERIALS AND METHODS

Study area

The study was conducted from 2010 to 2015 in Nargu Wildlife Sanctuary (NWS) ($31^0$46´36´´ to $32^0$04´00´´ N Latitudes and $76^0$50´00´´ to $77^0$04´30´´ E Longitudes) which is located in Chuhar valley of Mandi district of Himachal Pradesh (Figure 1). The Sanctuary, which was declared in 1972, is surrounded by Kullu, Mandi, Jogindernagar and Palampur Forest Divisions. It covers an area of over 278.38 km^2 with an altitudinal range, 970 – 4,052 m asl.

The whole area is mainly mountainous with undulating low hills in the west and steep to precipitous mountains in the north and east. There are numerous high ridges, deep gorges and cliffs and narrow valleys. The climate of the area is sub-tropical, temperate, sub-alpine and alpine and consists of summer (mid April-mid June), rainy (mid June-September) and winter (October-March) seasons. The area receives precipitation both in the form of snowfall and rainfall. About 80% of the precipitation is received by south-west monsoon and the rest by western disturbances. However, the Sanctuary is now rationalized as per notification (No. FFE-B-F(6)-16/1999-Nargu; Dated, 29 November 2013) of the Government of Himachal Pradesh, Department of Forests. The study was conducted in the non-rationalized area as it was proposed earlier to this notification.

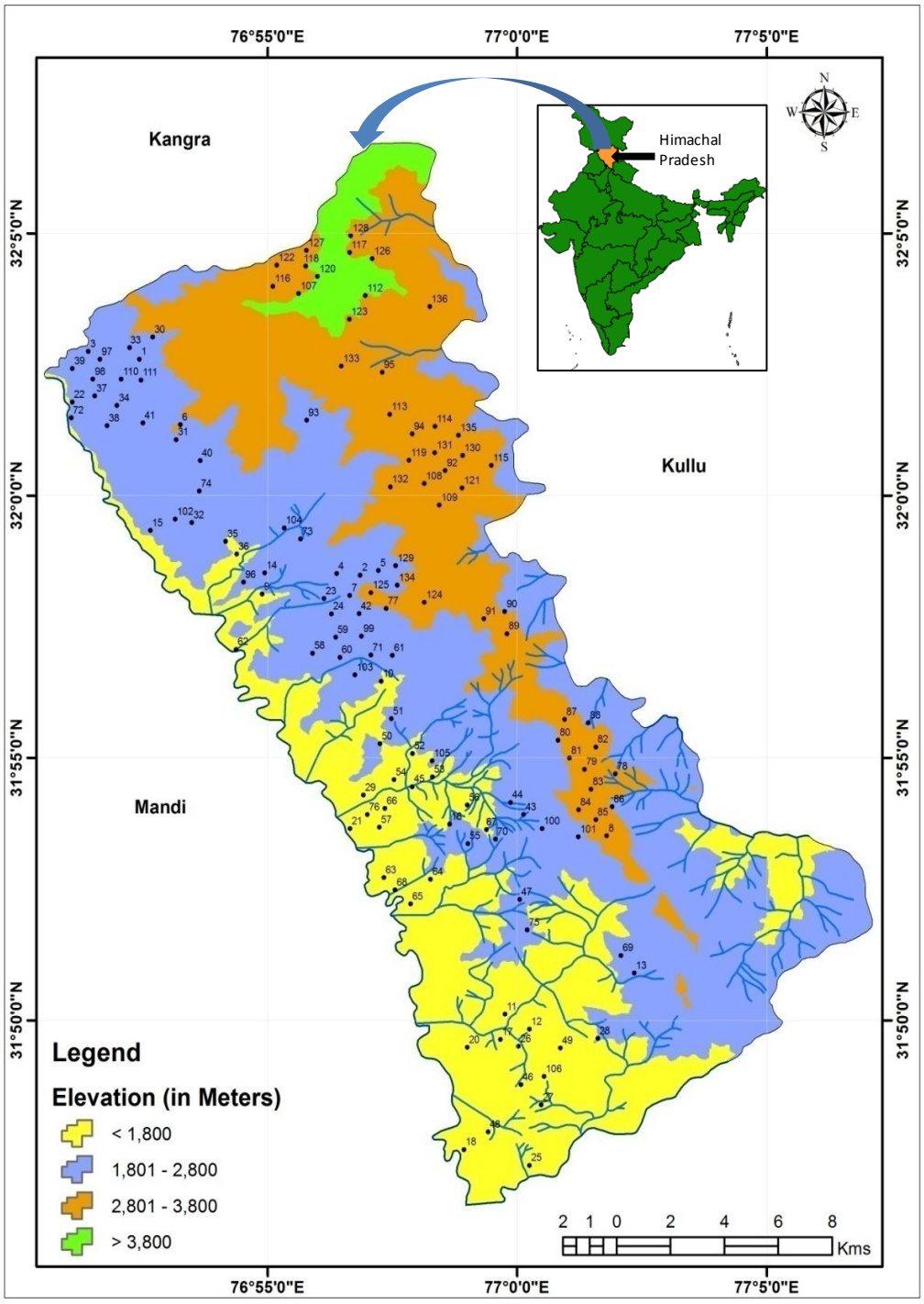

Figure 1: Elevation map of the NWS showing sampled sites (1-136).

Sampling

Number of surveys were conducted between 970 – 4,052 m in NWS in all the seasons 2010 to 2015 to investigate the stated objectives. Random sampling was done for the qualitative analysis of vegetation in all the seasons (summer, rainy and winters) for the floristic surveys. However, for the quantitative assessment for threat categories, the sampling was conducted during July to September each year. A total of 136 sites were sampled in NWS where, 111 sites were in forests and 25 sites were in alpine zones. In the forest zone, a plot of 50 × 50 m was laid in each site. For shrubs, 20 quadrats of 5 × 5 m, and for herbs, 20 quadrats of 1 × 1 m were randomly

laid within the same plot. Shrubs were considered as the woody species having several branches arising from their bottom (Saxena and Singh, 1982). For assessing the alpine vegetation in each site, a 20 × 20 m plot was laid and within it 10 quadrats of 5 × 5 m for shrubs and 20 quadrats of 1 × 1 m for herbs were randomly laid. Standard ecological methods (Saxena and Singh, 1982; Singh and Singh, 1992; Dhar *et al.*, 1997; Joshi and Samant, 2004; Samant and Joshi, 2005) were used for the collection and analysis of the data *viz*., population of the species *etc*. The Global Positioning System (Make; Garmin GPSmap76CSx) is used for recording the geo-references, altitude and aspect *etc*.The record of the indigenous uses is mostly based on the interviews done with the people during the surveys, however in the case of medicinal plants information on indigenous uses were updated with the help of relevant secondary information (Jain, 1991; Samant and Palni, 2000; Samant *et al.*, 2007). The interviews were conducted mostly on individual-basis, except in some cases, where several people participated at the same time. Interviews were done with the help of open and semi structured questionnaires.

The habitats in the sanctuary were identified based on the physical characters and dominance of vegetation. Moist and humus rich shady sites were considered as moist habitat while low percent of the same as dry habitat. The sites facing high anthropogenic pressure were considered as degraded habitats and sites having single large rock as rocky whereas others as used for camping by the shepherds or grazers as camping sites. The ones having >50% boulders of the ground cover were considered as bouldary and others nearby the water streams as riverine. The sites having submerged vegetation or having excess moisture are considered as marshy, alpines pastures as dry or grasslands as per the moisture content in the soil and others having >50% of shrubs were considered as shrublands.

Data analysis

Vegetation data

The nativity of a species denotes its origin or first record (Samant *et al.*, 1998) and has been identified (Anonymous, 1883-1970; Samant and Dhar, 1997; Samant *et al.*,1998, 2000; http://www.ipni.org). In case of Pteridophytes, the species distributed in the Himalayan Region have been considered as native to the region whereas the remaining species as non-natives. Endemism of the species has been identified based on distribution of the species (Dhar and Samant, 1993; Samant *et al.*,1998, 2000; Samant and Dhar, 1997; Samant, 1999). The species restricted to the Himalayan region have been considered as endemic.

For knowing the regional threat status of a particular species, Conservation Priority Index (CPI) was calculated to categorize species under different threat categories in the NWS (Rana and Samant, 2010). The cumulative values of the various attributes *viz*., habitat specificity, population size, distribution range, use values, extraction, nativity and endemism of the taxa were used to calculate the CPI for each species. To calculate CPI, the number of parameters used for each species was given grade/marks, maximum 10 point; moderate 6 points and minimum 2 points (Table 1). Therefore, the lowest grade minimum score *i.e*., 2 was assigned instead of zero. The species fulfilling all the attributes in the highest grade resulted in highest cumulative values and one which falls in the lowest for each attribute resulted in lowest cumulative values. The highest marks possible was 60, meaning all the characteristics were present and satisfactory for that particular taxa. The species having ≥60% of the total CPI were considered as 'Critically Endangered'; 55-59% as 'Endangered'; 50-54% as 'Vulnerable'; and 45-49% as Near Threatened, whereas <45% were considered as Least Concern (Rana and Samant, 2010).

The regionally threatened species of the NWS were compared to the threatened species of State and globe following (Nayar and Sastry, 1987-90; Ved *et al.*, 2003; Rana and Samant, 2010; Goraya *et al.*, 2013). The species, that was observed outside the sampled sites were also considered for categorization.

RESULTS

Threat Categorization and Species Diversity

The present study recorded 733 species of vascular plants i.e., angiosperms (113 families, 366 genera and 680 species), gymnosperms (3 families, 6 genera and 9 species) and pteridophytes (16 families, 25 genera and 44 species). Of the total species, 74 species were trees, 125 shrubs, 490 herbs and 44 pteridophytes. Among these, 102 species (20 Trees; 14 Shrubs; and 68 Herbs) belong to 82

genera and 54 families have been identified as 'threatened' from the NWS (Table 2). Out of the total, 66 species were cited in the sampled sites.

In the present study, 8 species were categorized as Critically Endangered, 17 species as Endangered; 77 species as Vulnerable, 158 species as Near Threatened and other 473 species as least concerned (Table 2). Species have been categorized as Critically Endangered (3 spp.); Endangered (13 spp.) and Vulnerable (29 ssp.) for Himachal Pradesh using IUCN criteria. Critically Endangered (1 spp.), Endangered (4 spp.) and Vulnerable (4 spp.) were identified according to the global threat categories.

Altitudinal distribution

In general maximum number of species (*i.e.*, 546 spp.) was recorded in the altitudinal zone, 1801-2800 m. The diversity decreased with the increasing altitude. Similarly, along an altitudinal gradient, the maximum threatened species (68 spp.) were distributed in 1801-2800m zone, followed by 2801- 3800 m (56 spp.) zone (Figure 2).

Site Wise Distribution

Among the 136 sites at NWS, a total of 589 species (Trees: 54; Shrubs: 85 and Herbs: 450) have been recorded. 514 species (Trees: 55; Shrubs: 83 and Herbs: 376) were reported from the forest zone and 282 species (Shrubs: 14; Herbs: 268) from the alpine zone. Eighty two (82) species were present in a single site, sixty four species (64) in two sites, fifty four species (54) in three sites, fifty eight species (58) in four sites, fifty two species (52) in five sites, twenty six species (26) in six sites and twenty three species (23) in seven sites. The rest of the 230 species were reported in more than seven sites.

Table 1: Attributes used for Threat Categorization of Species in NWS.

Grade/ marks	Altitudinal Range (m)	H	Use Values	Population Size/locations	Native & Endemic	Extraction
10	<500	1	> 4	<50 Ind or 2 locations	Native & Endemic	Commercial
6	500-1000	2-3	3-4	50-250 or 3-5 locations	Native/Endemic	Self-Use
2	>1000	>3	<3	>250 Ind or >5 locations	Non-native	No Extraction

Abbreviations Used: H= No. of Habitat (s); Ind= No. of individuals

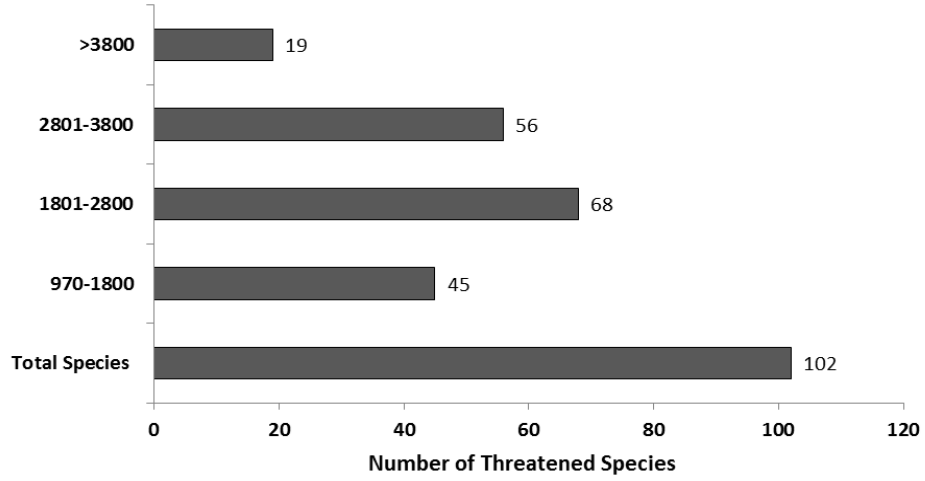

Figure 2: Altitudinal distribution of threatened plant species in NWS.

Distribution of plant species among different Habitat

Of the total species recorded, 14 were habitat specific, 176 were recorded in two habitats, 308 in three habitats and 235 in more than three habitat types. Of the threatened species reported, habitat wise distribution of the species in the forest and alpine zones of the sanctuary had 7 species only distributed in one habitat, 28 species in two habitats whereas 67 species were distributed in 3 or >3 habitats. Among the species, *Melothria heterophylla* (6 habitats), *Salvia lanata*, *Ribes alpestre*, *Lagotis cashmeriana*, *Juglans regia* and *Dioscorea deltoidea* (5 habitats, each), *Vincetoxicum hirudinaria*, *Viburnum mullaha*, *Trichosanthes tricuspidata*, *Thamnocalamus spathiflora*, *Swertia ciliata*, *Swertia angustifolia*, *Rhodiola heterodonta*, *Phegopteris connectilis*, *Olea ferruginea* and *Cinnamomum tamala* (4 habitats, each) were distributed among maximum number of habitats (Table 2).

Nativity and endemism

From the total recorded species, 414 species were native to the Himalayan Region, while the remaining species were exotics. Twelve species were endemic and 152 species near endemic to the IHR.Whereas among the threatened and near threatened species 184 species were native, 76 exotics, 10 endemic and 73 near endemic to the Indian Himalayas. However, of the quantified species about 68.3% were native to the Himalaya. About 20.3% of the total and 29.8% of the native species were near endemic and 1.9% of the total and 2.7 % of the natives were endemic to the IHR.

Extraction of species

A total of 552 species were identified as economically important plants (belonging to 120 families and 332 genera). These species were used as medicine (371 spp.), wild edible/food (131 spp.), fodder (206 spp.), fuel (87 spp.), fiber (12 spp.), religious (28 spp.), timber (14 spp.), making agricultural tools (16 spp.) and for miscellaneous domestic and commercial purposes.

Among threatened and near threatened species, 32 species were extracted for commercial purposes while 129 species extracted by inhabitants for their own use. For example, *Aconitum heterophyllum*, *Aesculus indica*, *Allium humile*, *Angelica glauca*, *Arnebia benthamii*, *Cedrus deodara*, *Dactylorhiza hatagirea*, *Dioscorea deltoidea*, *Habenaria edgeworthii*, *Juniperus indica*, *Jurinella macrocephala*, *Malaxis muscifera*, *Picea smithiana*, *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Rheum australe*, *Rhododendron arboreum*, *Taxus baccata* subsp.*wallichiana*, *Toona ciliata*, *Valeriana jatamansi* etc. are valued for various commercial purposes.

Population size and site representation

Among the quantified plants 32% species (190 spp.) had only < 50 individuals in the sampled sites, 37% (218 spp.) with population size of 51-250 individuals and 31% (181 spp.) with population size >250 individuals. One hundred forty four species were not represented in any sampled sites and they were considered as species with low population size.

Among the threatened species, 28 species had only <50 individuals in the sampled sites and 28 species with population size of 51-250 individuals and seven specieshad population size of >250 individuals.

DISCUSSION

Ecologists observe that the massive extinction of the species is occurring in high altitudinal areas like the Himalaya that have high biological diversity including many endemic species. At present, biodiversity crisis is being experienced throughout the world, therefore suitable conservation actions need to be set up for optimal use of limited resources. Studies indicate that we have altered approximately half of the habitable surface of the earth (Daily, 1995; Singh, 2002). Therefore, myriads of conservational approaches are being implemented in various ecosystems across the globe. Unfortunately, none of the available methods of setting conservation priorities are generally accepted, as their data requirements are too strict, scientifically unsound, or are too complex for the usage by decision makers (Schmeller *et al.*, 2008). Majority of the studies of setting the priorities for conservation of the plant species have been carried out using qualitative observations only. The IUCN status of the species is based on the published flora, reports and research papers which are typically based on qualitative observations. In addition, threat assessments were based on opinion and perception of specialists during workshops and

meetings (Ved *et al.*, 2003, 2005; Goraya *et al.*, 2013). Though, such exercises help in prioritizing species for conservation and management, they do not provide the authentic information on the actual status of the species, which is only possible through ground validation. Therefore, location specific studies are essential to set conservation priorities. For this purpose, assessment of the status of species using qualitative and quantitative attributes has only been suggested by few workers (Samant *et al.*, 1996; Airi *et al.*, 1997). Likewise, Rawal and Dhar (1997) have attempted to estimate the sensitivity of the timberline flora of Kumaun Himalaya based on habitat specificity, distribution range and population size, but others highlight the necessity of further thorough investigation (Rana and Samant, 2010).

The plant species are facing natural and anthropogenic threats at the NWS. The habitats of most of these threatened species fall within the extensively grazed alpine meadows and sub-alpine zones. Animals which browse leaves and reproductive parts of plant species damage their flowering spikes and thereby restrict their population size and distribution (Ganie and Tali, 2013). Most of the individuals of different species were not able to produce seeds because the flowers are extensively grazed by livestock threatening their long-term survival.

The population size, habitat specificity, nativity and endemism, distribution range and use pattern play a significant role in decision making of the status of a species in particular area. In the present study**,** threat assessment of floristic diversity for the NWS has been carried out for the first time. On the basis of cumulative values (*i.e*., CPI) of conservation attributes, species have been categorized. The higher CPI indicates the need for a greater level of attention to local strategies for conservation and management. Categorization of 8 species as Critically Endangered, 17 species as Endangered; 77 species as Vulnerable and 158 species as Near Threatened indicated the high degree of anthropogenic pressure in the area. Existence of species such as *Allium humile*, *Dactylorhiza hatagirea*, *Fritillaria roylei*, *Jurinella macrocephala*, *Aconitum heterophyllum*, *Angelica glauca*, *Dioscorea deltoidea*, *Malaxis muscifera*, *Picrorhiza kurrooa* and *Paris polyphylla* were highly threatened in the NWS as well as globally hence they have high conservation importance. Altering the land use, climate change, nitrogen deposition, biological exchange and atmospheric carbon dioxide are the major factors contributing towards change in biodiversity. Moreover, climate change is not been considered as a major threat for plants and therefore it is less important than the change in land use types (Sala *et al.*, 2000).

Pressure of human overpopulation and climate change interfere with the natural ecosystems and introduction of non-native species increase pressure on survival of the native species (Vitousek, 1990; Levine *et al.*, 2003; Serrill, 2006). Anthropogenic activities such as extraction of resources by humans, tourism and livestock grazing spread non-native species into the forested areas. Disturbance leads to the invasion of non-native species (Huston, 1994). Hence, there seems is a strong need for increased surveillance, early detection, and eradication of non-native and invasive species from the area as these out-compete the natives and destabilize the local ecosystem.

Altitudinal zone, 1801-2800m had the highest richness of threatened species. This may be due to heavy biotic pressure on this zone leading to habitat degradation and ultimately to extinction of the species. Besides, occurrence of 9 species in only one site and 8 species in two sites indicated the early extinction of these species if the habitat degradation and anthropogenic activities continue to operate. Similarly, occurrence of 7 species only in one habitat and 28 species in two habitats indicated their high habitat preferences. Such species have less chances of proliferation than the species with wide range of habitats (Samant *et al.*, 1996).

Species such as *Valeriana jatamansi* (35 sites, 3 habitats), *Bergenia ciliata* (29 sites, 2 habitats), *Thamnocalamus spathiflora* (21 sites, 4 habitats), *Hedychium spicatum* (20 sites, 3 habitats), *Viburnum mullaha* (19 sites, 4 habitats), *Parnassia nubicola* (12 sites, 4 habitats), and *Symplocos chinensis* (12 sites, 2 habitats), *Swertia angustifolia* (11 sites, 4 habitats) and *Skimmia laureola* (11 sites, 3 habitats), etc., had wide range of distribution and habitat preferences, due to over-exploitation for various purposes and habitat degradation, these species too facing high degree of threat. Amongst habitats, shady moist, rocky and dry forest habitats supports maximum number of

threatened species, hence these require priority for conservation.

However, the distribution of the preferred economically valuable species in the sanctuary indicated their availability in the area, but continuous exploitation of these species may lead to their population depletion. Low density of the preferred species indicated high anthropogenic pressure, which may lead to the extinction of these species in near future and replaced by the other less economically important species. This may too affect the regional ecology because imprudent use of plant resources is a direct threat to biodiversity and the continued proper functioning of mountain ecosystems (Sharma *et al.*, 2010; Tarraso´n *et al.*, 2010).

Nevertheless, the protected area systems are not entirely safe, thus the threatened species have no guarantee to remain safe (Krupnick, 2013). To maintain the viability of a threatened plant population in a protected area, the species must not suffer from the 'benign neglect' approach to conservation (Heywood and Iriondo, 2003). Species within protected areas must be monitored and actively managed. For long-term resilience of landscapes of the NWS that remain under cultivation or grazing, it is more important to create corridors of forest cover to encourage the dispersal agents that use them and prohibit any anthropogenic activity in the area. In addition to the above, an appropriate conservation strategy by periodical assessment of population and habitats' monitoring of the threatened species using standard ecological methods are suggested.

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Table 2: Status of the threatened plants in NWS.

Taxa	Family	Nativity	LF	AR (m)	Habitats	Status	
						HP	GB
Critically Endangered (CR)							
Aconitum heterophyllum Wall.ex Royle*	Ranunculaceae	Reg Himal	H	3000-4100	1,7,8	CR	CR
Allium humile Kunth*	Alliaceae	Reg Himal Ind Or	H	3200-4000	1,7	-	-
Allium wallichii Kunth	Alliaceae	Reg Himal	H	2500-4100	1,7	-	-
Dactylorhiza hatagirea D. Don	Orchidaceae	Reg Himal Europ Afr Bor Or	H	2800-3870	1,7	CR	-
Habenaria edgeworthii Hook.f. ex Collett*	Orchidaceae	Reg Himal	H	1500-3000	1	-	-
Malaxis muscifera (Lindl.) Kuntze	Orchidaceae	Europ	H	1800-3200	1,7	CR	-
Picrorhiza kurrooa Royle	Scrophulariaceae	Reg Himal	H	2800-3850	1,2,8	EN	-
Podophyllum hexandrum Royle	Podophyllaceae	Ind Or As Trop	H	2500-3700	1,7	EN	-
Endangered (EN)							
Acer caesium Wall. ex Brandis*	Aceraceae	Reg Himal	T	2100-3200	1,2,9	-	-
Aconitum violaceum Jacq. ex Stapf.*	Ranunculaceae	Reg Himal	H	3500-4000	1,7,8	VU	VU
Aconitum laeve Royle	Ranunculaceae	Reg Himal	H	2700-3000	1,7	-	-
Allium stracheyi Baker*	Alliaceae	Reg Himal	H	3600-3800	1	VU	VU
Angelica glauca Edgew. *	Apiaceae	Reg Himal	H	2000-2800	1,7	EN	EN
Berberis asiatica Roxb. ex DC.	Berberidaceae	Reg Himal	Sh	1200-2000	1,2	-	-
Betula utilis D. Don	Betulaceae	Reg Himal Japon	T	2700-3400	8,9	EN	-
Cinnamomum tamala (Buch.-Ham.) Nees & Ebermaeir	Lauraceae	Reg Himal	T	1000-1500	1,2,3	VU	-
Euonymus tingens Wall.	Celastraceae	Reg Himal	T	1700-2900	1,2,10	-	-
Fritillaria roylei Hk.	Liliaceae	Reg Himal	H	2700-3500	1	EN	EN
Hypericum perforatum L.	Hypericaceae	Europ	H	1100-2200	1,2,3,4	VU	-
Jurinella macrocephala (Benth. ex Hk. f.) Aswal & Malhotra	Asteraceae	Reg Himal	H	3000-3850	1,7	EN	-

Taxa	Family	Nativity	LF	AR (m)	Habitats	Status	
						HP	GB
Nervilia plicata L.	Orchidaceae	Reg Himal	H	1050-1200	5	-	-
Paris polyphylla Sm.	Liliaceae	Reg Himal China	H	1200-2200	1,2,3,	EN	-
Rhodiola heterodonta (Hk. & Th.) A. Boriss.*	Crassulaceae	Reg Himal	H	2930-4000	1,2,3,8	VU	VU
Taxus baccata ssp. *wallichiana* (Zucc.) Pilger	Taxaceae	Reg Himal	T	2500-3300	1,2	EN	-
Trillium govanianum Wall. ex D.Don	Trillidiaceae	Reg Himal	H	2300-3300	1,10	-	-
Vulnerable (VU)							
Acer cappadocicum Gled.	Aceraceae	Asia Minor	T	2600-3000	1,3	-	-
Acer oblongum Wall.	Aceraceae	Reg Himal	T	1400-1950	1,9	-	-
Acorus calamus L.	Araceae	Reg Bor Temp	H	1300-2200	5,11	-	-
Aerva sanguinolenta (L.) Bl.	Amaranthaceae	Java	H	1000-1200	1,2	-	-
Aralia cachemirica Decne.*	Araliaceae	Reg Himal	H	2500-3050	2,3	-	-
Asparagus racemosus Wild.	Asparagaceae	Ind Or Afr Trop Austr	H	1300-1700	1,2,4	-	-
Berberis aristata DC.*	Berberidaceae	Ind Or	Sh	1200-2800	10	-	-
Bergenia ciliata (Hew.) Stercb.*	Saxifragaceae	Reg Himal	H	2000-3500	2,3	-	-
Betula alnoides Buch.-Ham. ex D.Don	Betulaceae	Reg Himal Japon	T	1800-2500	1,2,4	-	-
Boschniakia himalaica Hk.f. & Th. ex Hk.f.	Orobanchaceae	Reg Himal	H	2700-3300	1	-	-
Bupleurum atroviolaceum (Schulz) Nasir*	Apiaceae	Pak Himal	H	2100-3000	1,7,8,	-	-
Campanula latifolia L.	Campanulaceae	Europ Or As Temp	H	2600-3500	2,3,8	-	-
Clintonia udensis Trautv. & Mey.	Liliaceae	Siberia Japon	H	3200-4000	1,7,10	-	-
Corydalis govaniana Wall.	Fumariaceae	Reg Himal	H	3000-4000	1,2,7	-	-
Corylus jacquemontii L.*	Corylaceae	Europe Or As Min Himal	T	2490-2900	1,5	-	-
Deeringia amaranthoides (Lam.) Merr.	Amaranthaceae	As et Afr Trop	Sh	1000-1400	1,2	-	-
Delphinium denudatum Wall. ex Hk. f. & Th.*	Ranunculaceae	Reg Himal	H	2000-2600	1,2,5	-	-
Desmodium gangeticum (L.) DC.	Fabaceae	As Trop Austr	Sh	1000-1500	1,2,3	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Dioscorea deltoidea Wall.	Dioscoreaceae	Ind Or	H	950-2500	1,2,3	EN	EN
Drepanostachyum falcatum (Nees) Keng f.	Poaceae	Reg Himal	Sh	1700-2200	1,2	-	-
Engelhardtia spicata Leschen. ex Bl.	Juglandiaceae	Reg Himal Malaya	T	1000-1600	1,2,3	-	-
Gymnopteris vestita (Wall. ex Moore) Underwood	Hemionitidaceae	-	Fn	1000-2500	1,2,3	-	-
Hedychium spicatum Sm.*	Zingiberaceae	Reg Himal	H	1000-2500	1,2,5	-	-
Heracleum candicans Wall. ex DC.	Apiaceae	Reg Himal	H	1500-2800	1,2,4	-	-
Heracleum wallichii DC*	Apiaceae	Reg Himal	H	3500-4000	1,9	-	-
Herminium monorchis (L.) R.Br.	Orchidaceae	Europ As Bor	H	2000-4000	1,5,7	-	-
Himalayacalamus falconeri Keng f.	Poaceae	Reg Himal	H	2000-3000	1,2,4	-	-
Juglans regia L.*	Juglandiaceae	Reg Himal As Occ	T	1700-3000	1,2,3,9	-	-
Lagotis cashmeriana Rupr.*	Scrophulariaceae	Reg Himal	H	3100-4100	1,3,6,7,8	-	-
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	Ind Or	T	980-1300	2,4,5	-	-
Leycesteria formosa Wall.	Caprifoliaceae	Reg Himal	H	1500-2800	1,2,4	-	-
Malaxis acuminata D. Don	Orchidaceae	Reg Himal	H	1600-2500	1	-	-
Melothria heterophylla (Lour.) Cogn.	Cucurbitaceae	As Trop et Sub Trop	H	2000-2500	1,2,4,5	-	-
Morus serrata Roxb.	Moraceae	Reg Himal	T	970-2300	2,3	-	-
Nepeta govaniana Benth.*	Lamiaceae	Reg Himal	H	1700-2800	1,2,7	-	-
Olea ferruginea Royle*	Oleaceae	Reg Himal	T	1300-1600	2,9	-	-
Osmunda japonica Thunb.	Osmundaceae	-	Fn	2100-2500	1,9	-	-
Parnassia nubicola Wall. ex Royle*	Parnassiaceae	Reg Himal	H	3000-4000	1,7,8	-	-
Parnassia pusilla Wall. ex Arn.	Parnassiaceae	Bhutan	H	2300-3600	1,7	-	-
Pellaea nitidula (Wall. ex Hk.) Hk. et Baker	Sinopteridaceae	-	Fn	2000-2300	1, 2, 6	-	-
Phegopteris connectilis Watt**.**	Thelypteridaceae	-	Fn	2600-3050	1,3,5,7	-	-
Phoenix humilis (L.) Cav.	Arecaceae	Ind Or	T	1000-1500	5	-	-
Phymatopteris stracheyi (Ching) Pic. Serm.	Polypodiaceae	-	Fn	2500-3300	1,2,4	-	-
Pistacia integerrima (Stewart) Rech. f.	Anacardiaceae	Egypt Persia Reg	T	1000-2200	1,2	-	-

Taxa	Family	Nativity	LF	AR (m)	Habitats	Status	
						HP	GB
		Himal					
Pleurospermum angelicoides (DC.) Cl.	Apiaceae	Reg Himal	H	3000-3650	1,2,7	-	-
Pleurospermum brunonis Cl.*	Apiaceae	Reg Himal	H	3000-3650	1,7	-	-
Pleurospermum candollii (DC.) Cl.*	Apiaceae	Reg Himal	H	3000-3850	1,7,8	-	-
Polygonatum multiflorum (L.) All.	Liliaceae	Europ As Bor	H	3000-4000	1,2	VU	-
Polygonatum verticillatum (L.) All.	Liliaceae	Europ As Bor	H	1700-3500	1,2,3	VU	-
Rheum australe D.Don*	Polygonaceae	Reg Himal	H	2500-3300	1,7,8	-	-
Rheum moorcroftianum Royle*	Polygonaceae	Reg Himal	H	3500-4100	1,7,8	EN	-
Rhododendron lepidotum Wall.	Ericaceae	Reg Himal	Sh	2700-3100	7,8,10	VU	-
Rhus cotinus L.	Anacardiaceae	Mediter Or Reg Himal China	Sh	1100-1800	1,2,3	-	-
Rhus wallichii Hk.f.*	Anacardiaceae	Reg Himal	T	1500-2400	1,2,4	-	-
Ribes alpestre Wall. ex Decne.	Grossulariaceae	China Xizang	Sh	2000-3300	1,2,5,10	-	-
Roylea cinerea Wall. Ex Benth.*	Lamiaceae	Reg Himal	Sh	1200-3700	1,3,7,9	VU	VU
Salvia lanata Roxb.*	Lamiaceae	Reg Himal	H	1400-2500	1,2,3,10	-	-
Sambucus adnata Wall.	Caprifoliaceae	Reg Himal	H	2500-2710	1,3	-	-
Saussurea taraxacifolia Wall. ex DC.	Asteraceae	Reg Himal	H	3100-3600	1,7,8	-	-
Skimmia laureola Sieb. & Zucc. ex Walp.	Rutaceae	Reg Himal	Sh	1200-2800	1,2,10	-	-
Sorbus lanata (D.Don) Schauer	Rosaceae	Reg Himal	T	2100-3000	1,2	-	-
Swertia cordata Wall.*	Gentianaceae	Reg Himal	H	2700-3500	1,2,7	-	-
Swertia angustifolia Ham. ex D. Don	Gentianaceae	Reg Himal	H	1500-3000	1,6,7,8	-	-
Swertia cilliata (G.Don) Burtt*	Gentianaceae	Reg Himal	H	2700-4000	1,2,7,8	-	-
Symplocos chinensis (Lour.) Decne.	Symplocaceae	Japon	T	1200-2600	1,2	-	-
Tanacetum dolichophyllum Kitamura	Asteraceae	Mexico	H	3000-4000	1,7	-	-
Thamnocalamus spathiflora (Trin.) Munro*	Poaceae	Reg Himal	Sh	1000-3000	1,2,3,4	-	-
Toona ciliata M. Roem.	Meliaceae	Malaya Austr	T	1000-1500	1	-	-
Trichosanthes tricuspidata Lour.	Cucurbitaceae	China	H	1300-2000	1,2	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Valeriana hardwickii Wall.	Valerianaceae	Reg Himal Malaya	H	2000-3050	1,7,8	-	-
Valeriana jatamansi Jones	Valerianaceae	Reg Himal	H	1400-3000	1,7,8	VU	-
Vanda cristata Lindl.	Orchidaceae	Reg Himal As Trop	H	1300-2100	1	-	-
Viburnum grandiflorum Wall. ex DC.*	Caprifoliaceae	Reg Himal	Sh	2500-3000	1,2,10	-	-
Viburnum mullaha Buch.-Ham. ex D. Don	Caprifoliaceae	Reg Himal	Sh	1800-2500	1,2,3,10	-	-
Vincetoxicum hirudinaria Medik.	Asclepiadaceae	Europ Reg Cauc	H	1500-2800	1,2,7	-	-
Zanthoxylum armatum DC.	Rutaceae	Reg Himal China	Sh	1000-2500	2,4,10	EN	-
Zingiber chrysanthum Ros.	Zingiberaceae	Reg Himal	H	1200-1700	1,5	-	-
Near Threatened							
Acer acuminatum Wall. ex D.Don*	Aceraceae	Reg Himal	T	2900-3100	1,9	-	-
Aechmanthera gossypina Nees	Acanthaceae	Ind Or	Sh	1000-2200	1, 4	-	-
Aesculus indica Coleb. ex Wall.*	Hippocastanaceae	Reg Himal	T	1500-2800	1,2,3,4	-	-
Agave angustifolia Haw.	Agavaceae	Mexico	H	1300-1600	2,4	-	-
Ajugabracteosa Wall. ex Benth.	Lamiaceae	Afr Trop Ind Or As	H	1000-2500	1,2,3,4	-	-
Alangium chinense (Lour.) Harms.	Cornaceae	Ind Or China Japon	T	1500-2200	1,2,5	-	-
Albizia odoratissima (L.f.) Benth.	Mimosaceae	As Afr Trop	T	1000-1500	2	-	-
Anemone vitifolia Buch-Ham	Ranunculaceae	Reg Himal	H	1600-2800	1,4,8	-	-
Aquilegia pubiflora Wall. ex Royle*	Ranunculaceae	Ind Or	H	1600-2600	1,5	-	-
Arenaria pulvinata Edgew.	Caryophyllaceae	Reg Himal	H	3300-3600	2,8,9	-	-
Artemisia roxburghiana Bess.*	Asteraceae	Reg Himal	H	1000-2700	1,2,4,5	-	-
Asclepias curassavica L.	Asclepiadaceae	Am Austr	Sh	980-1200	1	-	-
Asplenium trichomanes Cl.	Aspleniaceae	Japon China	Fn	1000-3000	1,9	-	-
Astragalus chlorostachys Lindl*	Fabaceae	Reg Himal	Sh	1500-2500	1,3	-	-
Astragalus himalayanus Klotz.*	Fabaceae	Reg Himal	H	3000-4000	7,8	-	-
Bauhinia vahlii Wight & Arn.	Caesalpiniaceae	Ind Or	Sh	970-1300	2,3,4	-	-
Bauhinia variegata L.	Caesalpiniaceae	Ind Or Burma China	T	950-1400	1,2,10	-	-
Berberis lycium Royle*	Berberidaceae	Reg Himal	Sh	1000-2700	1,2,4,8	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Bergenia stracheyi (Hk. f. & Th.) Engl.*	Saxifragaceae	Reg Himal	H	2700-3650	3,9	VU	-
Boenninghausenia albiflora (Hk.f.) Reichenb.ex Meissn.	Rutaceae	Reg Himal Japon	H	1200-2800	1,2	-	-
Buddleja crispa Benth.	Loganiaceae	Reg Himal Burma	Sh	1700-2800	1,2,5,9	-	-
Bupleurum candolii Wall.ex DC.*	Apiaceae	Reg Himal	H	2700-3500	1,7,8	-	-
Bupleurum hamiltonii Balakr	Apiaceae	Reg Himal	H	1900-2500	1,3	-	-
Calanthe tricarinata Lindl.	Orchidaceae	Reg Himal	H	2000-3300	1,2	-	-
Caltha palustris L.*	Ranunculaceae	Ind Or	H	2000-2600	1,11	-	-
Carissa opaca Stapf. ex Haines	Apocynaceae	Reg Himal	Sh	1000-1500	1,2,4	-	-
Carpinus viminea Lindl.	Corylaceae	Reg Himal	T	1500-2200	1,2,4,5	-	-
Centipeda minima (L.) A.Br. & Asch.	Asteraceae	As et Austr Trop Ins Pacif	H	1300-1700	1,2,4,9	-	-
Cerastium fontanum Baumg. subsp. *membranaceum* (Edgew. & Hook.f.)	Caryophyllaceae	Europ	H	2500-4000	2,4,9	-	-
Ceropegia wallichii Wight	Asclepiadaceae	Reg Himal	H	2500-2900	1,2	-	-
Chaerophyllum acuminatum Lindl.	Apiaceae	Reg Himal	H	1800-3100	1,2	-	-
Chaerophyllum reflexum Lindl.	Apiaceae	Reg Himal	H	2200-3000	1,2,4	-	-
Chaerophyllum villosum Wall. ex DC.*	Apiaceae	Reg Himal	H	2000-3000	1,2,4	-	-
Cheilanthes acrostica Tod.	Sinopteridaceae	-	Fn	1000-2200	1,5	-	-
Cissus repanda Vahl	Vitaceae	Ind Or	Sh	1400-1600	1,2	-	-
Clematis barbellata Edgew.*	Ranunculaceae	Reg Himal	Sh	990-2800	2,4	-	-
Clematis buchananiana DC.	Ranunculaceae	Reg Himal	Sh	1500-3300	2,4	-	-
Clematis graveolens Lindl.	Ranunculaceae	Reg Himal	Sh	2000-3000	2,3,4,10	-	-
Clematis montana Buch.-Ham. ex DC.	Ranunculaceae	Reg Himal	Sh	1000-2300	3,10	-	-
Colocasia affinis Schott	Araceae	Reg Himal	H	1200-1700	1,2	-	-
Coniogramme affinis (Wall.) Hieron	Hemionitidaceae	-	Fn	2000-3000	1,7,8	-	-
Coniogramme falcata Salomon	Hemionitidaceae	-	Fn	2000-2800	1,8	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Coniogramme intermedia Hieron.	Hemionitidaceae	-	Fn		1,7	-	-
Coriaria nepalensis Wall.	Coriariaceae	Reg Himal China	Sh	1700-2400	2,4,10	-	-
Cornus capitata Wall.	Cornaceae	Reg Himal	T	1200-2300	1,2,4	-	-
Corydalis cashmeriana Royle*	Fumariaceae	Reg Himal	H	2800-3800	1,2,6	-	-
Corydalis cornuta Royle	Fumariaceae	Reg Himal	H	2400-3500	1,2,7,8	-	-
Corydalis vaginans Royle	Fumariaceae	Reg Himal	H	2500-2800	1,2,7,8	-	-
Cotoneaster bacillaris Wall. ex Lindl.*	Rosaceae	Reg Himal	Sh	1700-3200	1,2,3,8	-	-
Cryptogramma stellerii (Gmel.) Prantl	Cryptogrammaceae	-	Fn	2700-4000	1,3,9	-	-
Cryptolepis buchananii Roem. & Schultes	Asclepiadaceae	Ind Or	Sh	1300-1800	1,3	-	-
Cyathula capitata Moq.	Amaranthaceae	Reg Himal	H	1200-2600	1,4	-	-
Cyathula tomentosa (Roth) Moq.	Amaranthaceae	Reg Himal	Sh	1000-2400	2,3	-	-
Cystopteris fragilis (L.) Bernh.	Athyriaceae	Ind Or	Fn	2500-3500	1,7,9	-	-
Dianthus angulatus Royleex Benth.	Caryophyllaceae	Reg Himal	H	2400-3550	2,7	-	-
Dioscorea belophylla (Prain) Haines	Dioscoreaceae	Ind Trop	H	1000-1700	1,2	-	-
Dioscorea bulbifera L.	Dioscoreaceae	As Trop	H	1000-2100	1,2	-	-
Diplazium spectabile Ching.	Athyriaceae	-	Fn	1800-2400	1,5	-	-
Dryopteris cochleata (D. Don) C. Chr.	Dryopteridaceae	-	Fn	1300-1600	1,2,4	-	-
Dryopteris panda (C.B. Clarke) Chr.	Dryopteridaceae	-	Fn	2000-2500	1,2,4,5	-	-
Elaeagnus conferta Wall. ex Royle	Elaeaganaceae	Ind Or	Sh	1000-2600	1,2,4	-	-
Epipactis helleborine (L.) Crantz	Orchidaceae	Reg Himal	H	2500-3650	1	-	-
Euonymus fimbriatus Wall.	Celastraceae	Reg Himal	T	1200-2800	1,2,4,10	-	-
Ficus nemoralis Wall.	Moraceae	Reg Himal	T	1000-2000	2	-	-
Geranium wallichianum D.Don ex Sw.*	Geraniaceae	Reg Himal	H	2500-3100	1,2,7,8	-	-
Geum roylei Wall. ex Bolle	Rosaceae	Reg Himal Bor Occ	H	2600-3500	1,2,7	-	-
Goodyera fusca Hook.f.	Orchidaceae	Reg Himal	H	3000-3900	1,8,9	-	-
Habenaria pectinata D.Don*	Orchidaceae	Reg Himal	H	1400-3500	1	-	-
Herpetospermum pedunculosum (Serin.) Cl.	Cucurbitaceae	Reg Himal	H	2200-2500	1,2	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Hypoxis aurea Lour.	Hypoxidaceae	China	H	1600-2000	1,2,4,6	-	-
Ilex dipyrena Wall.	Aquifoliaceae	Reg Himal	T	1500-2900	1,2	-	-
Ilex excelsa (Wall.) Hk.	Aquifoliaceae	Reg Himal	T	1600-2400	1,4	-	-
Jasminum dispermum Wall.	Oleaceae	Reg Himal	Sh	1500-2000	2,4	-	-
Jasminum officinale L.	Oleaceae	Ind Bor Occ China	Sh	1200-3000	2,4	-	-
Juniperus communis L.	Cupressaceae	Reg Bor Temp et Arct	Sh	2800-3500	1,6,7,8	-	-
Juniperus indica Bertol.	Cupressaceae	Europ	Sh	3000-3600	1,7,8	-	-
Lonicera myrtillus Hk.f.& Th.	Caprifoliaceae	Reg Himal	Sh	2800-3100	1,2,10	-	-
Lonicera obovata Royle ex Hk.f.*	Caprifoliaceae	Reg Himal	Sh	2700-3100	1,3	-	-
Lonicera quinquelocularis Hardw.	Caprifoliaceae	Reg Himal	Sh	1000-2500	1,2,9	-	-
Lyonia ovalifolia (Wall.) Drude	Ericaceae	China	T	1200-2700	1,2,3,9	-	-
Marsdenia lucida Hk.f. & Thom.	Asclepiadaceae	Reg Himal Nepal	Sh	980-1300	1.3	-	-
Meconopsis aculeata Royle*	Papaveraceae	Reg Himal	H	3200-3500	7,8	EN	EN
Melia azedarach L.	Meliaceae	Reg Himal	T	1000-1500	1	-	-
Meliosma dilleniifolia Walp.	Sabiaceae	Reg Himal	T	1800-2600	1,2,4	-	-
Morina coulteriana Royle*	Morinaceae	Reg Himal	H	2960-3455	1,7,8	-	-
Morina longifolia Wall. ex DC.*	Morinaceae	Reg Himal	H	2500-4000	3,7,8	-	-
Myrica esculenta Buch.-Ham. ex D.Don	Myricaceae	As Trop et Subtrop	T	1300-2600	1,2,4,5	-	-
Neottia listeroides Lindl.	Orchidaceae	Reg Himal	H	1800-3600	1	-	-
Ophioglossum petiolatum Hk.	Ophioglossaceae	-	Fn	2000-2100	1,2,3,4	-	-
Parnassia asarifolia Vent.	Parnassiaceae	Temp Amer Afr Europ As	H	2400-3000	1,7,8	-	-
Peristrophe bicalyculata (Retz.) Nees	Acanthaceae	As et Afr Trop	H	1000-1600	1,,2,4	-	-
Phyllanthus emblica L.	Euphorbiaceae	As Trop	T	970-1400	2,4	-	-
Phytolacca acinosa Roxb.	Phytolaccaceae	Reg Himal China	H	1500-3000	1,3,9	-	-
Pimpinella acuminata (Edgew.) Cl.*	Apiaceae	Reg Himal	H	2600-3700	1,3,5	-	-
Pimpinella diversifolia DC.	Apiaceae	Reg Himal China	H	2000-3200	2,3,5	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Plantago himalaica Pilger*	Plantaginaceae	Reg Himal	H	1100-3000	1,2	-	-
Polygonatum cirrhifolium (Wall.) Royle	Liliaceae	Reg Himal As Bor	H	1800-2300	1,5,10	EN	-
Polygonum hydropiper L.	Polygonaceae	Reg Temp Bor et Aust	H	980-2400	1,5,11	-	-
Polygonum recumbens Royle ex Bab.	Polygonaceae	Reg Himal	H	1400-3000	2,3,4	-	-
Polystichum nepalense (Spreng.) C. Chr.	Dryopteridaceae	-	Fn	2000-2600	1,2,5	-	-
Polystichum lachenense (Hook.) Bedd.	Dryopteridaceae	-	Fn	2800-3500	1,6	-	-
Potentilla eriocarpa Wall. ex Lehm.*	Rosaceae	Reg Himal	H	2600-3600	1,7,8	-	-
Potentilla fulgens Wall.	Rosaceae	Reg Himal	H	2000-3200	1,3,7	-	-
Primula elliptica Royle	Primulaceae	Reg Himal	H	3600-4000	7,8	-	-
Primula involucrata Wall.	Primulaceae	Europ As Bor	H	3000-4000	7,8	-	-
Primula rosea Royle*	Primulaceae	Reg Himal	H	2500-4000	1,7,8	-	-
Prunus cerasoides D. Don	Rosaceae	Reg Himal	T	2790-3200	1,2	-	-
Pteris pseudoquadriaurita Khullar	Pteridaceae	-	Fn	1000-2400	1,2,4,5	-	-
Pteris quadriaurita Retz.	Pteridaceae	-	Fn	1000-2400	1,2,5	-	-
Quercus leucotrichophora A. Camus	Fagaceae	Reg Himal	T	1000-2600	1,2,4	-	-
Rhodiola himalensis (D.Don) S.H. Fu	Crassulaceae	Reg Himal	H	3000-4100	1,2,3,8	-	-
Rhododendron anthopogon D.Don*	Ericaceae	As Bor Reg Himal	Sh	3000-4100	7,8	VU	-
Rhododendron arboreum Sm.	Ericaceae	Ind Or Reg Himal Zeylan	T	1000-2300	1,2,4	-	-
Rhododendron campanulatum D.Don*	Ericaceae	Reg Himal	Sh	2600-3100	1,2,8,10	VU	-
Rhus javanica L.	Anacardiaceae	Reg Himal China	T	1200-2500	2,4	-	-
Rhus parviflora Roxb.	Anacardiaceae	Reg Himal	Sh	980-1350	2	-	-
Ribes glaciale Wall.	Grossulariaceae	Reg Himal	Sh	2000-3000	1,2,10	-	-
Ribes himalense Royle ex Decne.	Grossulariaceae	Europ Afr Bor Reg Himal	Sh	2700-3100	1,2,3,9,10	-	-
Rorippa indica (L.) Hiern	Brassicaceae	Ind Or China Malaya	H	1800-2300	1,2	-	-
Rosa webbiana Wall. ex Royle*	Rosaceae	Reg Himal	Sh	2300-3800	2,8,10	-	-

Taxa	Family	Nativity	LF	AR (m)	Habitats	Status	
						HP	GB
Roscoea purpurea Sm.	Zingiberaceae	Reg Himal Burma	H	2000-3000	1,7,10	-	-
Rubia manjith Roxb. Ex Fleming	Rubiaceae	As Trop et Temp Afr Trop	Sh	2000-2500	1,2,10	-	-
Rubus paniculatus Sm.*	Rosaceae	Reg Himal	Sh	1000-2500	2,4,10	-	-
Rumex acetosa L.	Polygonaceae	Europ As Borv	H	1000-3100	1,2,4,6	-	-
Salix tetrasperma Roxb.	Salicaceae	Ind Or Malaya	T	1500-2300	1,2,3	-	-
Salix wallichiana Anders.	Salicaceae	Reg Himal	T	1500-2800	1,2	-	-
Salvia nubicola Wall.	Lamiaceae	Europ Austr Or	H	1400-2200	1,2,10	-	-
Sanicula elata Buch.-Ham. ex D.Don	Apiaceae	Europ As Bor Afr Austr	H	2300-3200	1,2	-	-
Satyrium nepalense D.Don*	Orchidaceae	Reg Himal	H	1500-3200	1,7	-	-
Saussurea atkinsonii Cl.	Asteraceae	Reg Himal	H	3200-4100	8, 9	-	-
Saussurea albescens (DC.) Sch.-Bip.*	Asteraceae	Reg Himal	H	3000-3500	1,3	-	-
Saussurea deltoidea (DC.) Sch.-Bip.	Asteraceae	Reg Himal	H	2800-3300	7,8,9	-	-
Saussurea fastuosa (Decne) Sch.-Bip.*	Asteraceae	Reg Himal	H	2800-3300	1,3,7	-	-
Saussurea heteromala (D. Don) Hand.-Mazz.	Asteraceae	Reg Himal	H	2800-3000	1,7,8	-	-
Saxifraga sibirica L.	Saxifragaceae	As Bor et Arct	H	3000-3850	2,3	-	-
Scrophularia himalensis Royle*	Scrophulariaceae	Reg Himal	H	2200-2700	1,2,7	-	-
Selinum candollii DC.*	Apiaceae	Reg Himal	H	2000-4000	1,6	-	-
Selinum tenuifolium Wall.*	Apiaceae	Reg Himal	H	2600-3100	1,2,7	-	-
Selinum vaginatum (Edgew.) Cl.	Apiaceae	Reg Himal	H	2600-3100	1,2,4	-	-
Senecio cappa Buch.-Ham. ex D.Don	Asteraceae	Reg Himal	H	2400-2800	7,8	-	-
Sorbus foliolosa (Wall.) Spach*	Rosaceae	Reg Himal	Sh	2700-3800	1,10	-	-
Spiranthes sinensis (Pers.) Ames.	Orchidaceae	China As Temp	H	1100-2800	1,4	-	-
Stellaria himalayensis Majumdar*	Caryophyllaceae	Reg Himal	H	1500-2800	2,9	-	-
Stellaria monosperma D.Don*	Caryophyllaceae	Reg Himal	H	1700-2700	1,3,9	-	-
Strobilanthes wallichii Nees*	Acanthaceae	Reg Himal	H	2000-2800	1,3,9	-	-

Taxa	**Family**	**Nativity**	**LF**	**AR (m)**	**Habitats**	**Status**	
						HP	GB
Swertia alternifolia Royle	Gentianaceae	Reg Himal	H	2800-3300	7,8	-	-
Swertia cuneata D.Don*	Gentianaceae	Reg Himal	H	3200-4100	7,8	-	-
Swertia paniculata Wall.*	Gentianaceae	Reg Himal	H	2000-3500	1,2,7,8	-	-
Swertia petiolata D.Don	Gentianaceae	Reg Himal	H	3800-4100	1,7,8	-	-
Thalictrum foliolosum DC.*	Ranunculaceae	Reg Himal	H	1700-3300	1,2,3,8	-	-
Thymus linearis Benth.	Lamiaceae	Europ As et Afr Bor	H	2000-3000	1,2,3,4,9,10	-	-
Thysanolaena maxima Kuntze	Poaceae	As Trop	H	1000-1600	1,2,5	-	-
Ulmus villosa Brandis ex Gamble*	Ulmaceae	Ind Or As Temp	T	2200-2800	1,2,4	-	-
Ulmus wallichiana Planch.*	Ulmaceae	Ind Or	T	1500-2200		-	-
Verbena officinalis L.	Verbenaceae	Europ Mediter	H	1300-1700	1,2,4	-	-
Viburnum cotinifolium D.Don	Caprifoliaceae	Am Bor	Sh	2000-2600	1,2,3,10	-	-
Viburnum nervosum D.Don*	Caprifoliaceae	Reg Himal	Sh	2200-3050	1,2,4,10	-	-
Woodsia cycloloba Hand.-Mazz.	Woodsiaceae	-	Fn	3200-3500	1,7	-	-

Abbreviations Used: AR=Altitudinal Range; **CR=**Critically Endangered; **EN=**Endangered; **Fn=**Fern; **GB**=Global; **H=**Herb; **HP=**Himachal Pradesh; **LC=**Least Concern; **LF=**Life Form**; N**=Nativity; **R=**Rare; **Sh=**Shrub; **SR=**Site Representation; **T=**Tree; **VU=**Vulnerable**; Nativity:** Afr=Africa; Alp=Alpine; Amer=America; Amphig= Amphigaea; Arab=Arabia; Arct=Arctic; As=Asia; Austr=Australia;Bor=Borealis; et=And; Europ=Europe;Himal=Himalayan; Ind=Indian; Mediterr=Mediterranean; Min=Minor; Occ=Occidentalis; Or=Orientalis; Pacif=Pacific; Reg=Region; Sibir=Siberia; Temp=Temperate; Trop=Tropical; **1**=Shady Moist; **2**=Dry; **3**=Rocky; **4**=Degraded; **5**=Riverine; **6**=Camping site; **7**=Alpine grasslands; **8**=Dry alpine slope; **9**=Bouldary; **10**=Shrublands, **11**=Marshy; ***=**Endemic