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Floristic Diversity of Vascular Plants in Sikles Region of Annapurna Conservation Area, Nepal

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Abstract

Scientific investigation of floristic diversity is an essential prerequisite for conservation, management and sustainable utilization. The present study was conducted to explore the floristic diversity and life forms in Sikles region of Annapurna Conservation Area. Repeated field surveys with vegetation sampling and herbarium collection were done to find out floristic composition of the area. The study documented a total of 295 vascular plant species belonging to 238 genera and 107 families, including 25 species of fern and fern allies, 5 species of gymnosperms and 265 species of angiosperms. Herbs were dominant life form with 192 species followed by trees with 50 species whereas shrubs and climbers were 35 and 18 respectively. Asteraceae and Rosaceae (18 species each), Poaceae (17 species), Orchidaceae (16 species), Ranunculaceae (9 species) and Asparagaceae (8 species) were found to be dominant families in the region. *Impatiens* was the largest genera with 5 species followed by *Rubus* (4 species). *Begonia*, *Berberis*, *Swertia* had 3 species each. The life form classification shows the dominance of phanerophytes (29.27 %), therophytes (24.46 %) and chamaephytes (17.37 %) in the region. The rich flora of different taxonomic categories with both Eastern and Western Himalayan elements reflects the floristic importance of the region.

Keywords: Conservation, Eastern Himalaya, Flora, Life forms, Protected area

Introduction

Biodiversity is the heritage of millions of years of evolution. The enormous variety of life on earth is the result of complex interactions among all living organisms including microscopic species (Dirzo & Raven, 2003). Himalayan region, with long altitudinal gradients and climatic complexities, is considered as the biodiversity hotspot with rich vegetation, community and floral diversity (Sharma et al., 2014). The diversity of native flora is an important component of terrestrial ecosystems that has a primary role in protecting the environmental stability of a region (Lohbeck et al., 2016). Biodiversity is important for our survival as it provides us with various ecosystem services and goods (Chaudhary, 1998).

Human activities are continuously changing the world's terrestrial, freshwater and marine ecosystems and these changes are resulting in the loss of many species (Chapin et al., 2000), which calls for biodiversity conservation. The first and foremost step in this direction is to measure biodiversity occurring in various regions of the earth periodically. A measure of number of species present (species richness) at a given site, in a given area or country and, ultimately, in the whole world, is still the most straightforward and, in many ways, the most useful measure of biodiversity (Shaheen et al., 2012).

Floristic study refers to the documentation of all plants species in a given geographical region (Simpson, 2006). Floristic study is necessary to understand the present diversity status and conservation of forest biodiversity. It has been realized that the study of local or regional flora is of much more significance than those covering big areas because explorations can be carried out intensively in small areas. Understanding species diversity and distribution patterns is important to evaluate the complexity and resources of these forests. Floristic studies include species lists, life-form spectra, geographical distribution, and identification of threatened species that are useful

for evaluating ecological issues such as biodiversity, growth capacity, conservation and regulation (Ali et al., 2018). Thus, floristic studies could provide valuable data which could be used as reference for future studies. The results of such floristic works mostly come in the form of floras (Palmer et al., 1995) which may be local, regional or national. According to Takhtajan (1986), Nepal lies in transitional zone between Eastern and Western Himalayan flora; therefore, due to the topographic and climatic variations high diversity of vascular plants can be seen in different parts of the countries.

Raunkiaer (1934) proposed the term "Biological Spectrum" to express both the life form distribution in a flora and the phytoclimate under which the prevailing life forms evolved. Life form study is thus an important part of vegetation description, ranking next to floristic composition. The basic life form categories include phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes (Raunkiaer, 1934). Life forms depend on genetic as well as environmental factors because the environmental factors can affect the formation of different critical forms of plants (Shah et al., 2013). Accordingly, in different communities and different regions, plants can have different life forms. The biological spectrum is helpful in comparing geographically far and wide separated plant communities, and is used as an indicator of prevailing environment.

The aim of this study was to explore the floristic composition and plant diversity as well as to find out biological life form spectrum of plants in Sikles region, the southern part of Annapurna Conservation Area, which will help to outline further conservation measures to protect the diversity of the area.

Materials and Methods

Study site

The study was carried out in the Sikles area of Madi Rural Municipality located in the southern part of Annapurna Conservation Area, Kaski District, Gandaki Province. Diverse forest patterns are found in nearby Parche and Sikles villages providing communities with basic services. The forest floor is uneven and elevation ranges from 2000 to 3300 m asl. Geographically, it is located within the coordinate range of 28°28'N-28°47'N latitude and 84°00'E-84°42'E longitude (Figure 1).

The climate of the study area ranges from upper subtropical to lower alpine mostly covering temperate region. The climate is influenced by monsoon with temperate climate in lower elevation while subalpine in higher elevation. Records of Department of Hydrology and Meteorology for the last 8 years (2010-2017) shows maximum annual temperature of 21.9°C and minimum of 12.2°C. The average annual precipitation is 575 mm with maximum mean precipitation of 1020.25 mm in July (Department of Hydrology & Metrology [DHM], 2018).

According to the altitudinal zone and climatic variations *Alnus* forests, mixed forests, broad leaved forests, evergreen forests and bushes and grasslands are seen in the area. Lower area of dense canopy forest and higher alpine meadow area creates suitable habitats for different ungulate species of animals.

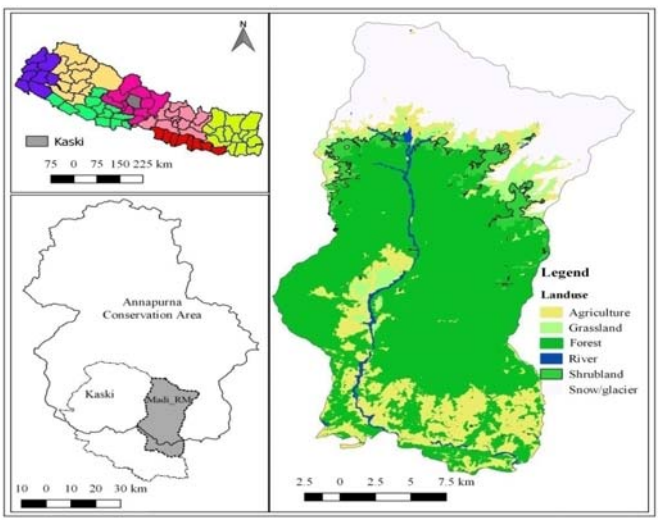

Figure 1: Land use classification map of the study area

Research approval

Prior to undertaking the research, the objectives were discussed with the management authorities of Annapurna Conservation Area. The permission for field work was taken from the Department of National Parks and Wildlife Conservation

(DNPWC) and Annapurna Conservation Area Project (ACAP).

Field survey

The field study was carried out from June 2018 to January 2019 within the elevation range of 2000-4000 m covering different habitat types and vegetation zones. Data on floristic composition of the area were collected by stratified random sampling (Behera et al., 2005; Panthi et al., 2007). The study area within altitudinal range of 2000-4000 m was divided into six sampling sites characterizing different altitudes, forest types and habitats. The sites were Raising Danda, Mouja-Prolu, Thasa Kharka, Chyomi, Tinje and Kori. Altogether 60 plots (10 m × 10 m) were studied in six sampling sites (10 in each). Sampling plots within the sites were selected using reference site such as walking trail. The distance between two plots in each sampling sites was approximately 100 m.

Raising Danda site was located within the altitudinal range of 2000-2300 m. The vegetation was mostly dominated by *Alnus nepalensis* and the community composed of *Daphniphyllum himalayense*, *Viburnum erubescens* and *Brucea javanica*. The altitudinal range of Mouja-Prolu was 2300 2600 m. The mixed forest type was seen in this range with the species of *Symplocos ramosissima*, *Eurya acuminate*, *Lyonia ovalifolia* and *Elaeagnus parvifolia*. Tasha Kharka area was located in the altitudinal range of 2600-2800 m. Species such as *Ilex dipyrena*, *Hydrangea heteromalla* and *Acer cappadocicum* were found with *Rhododendron arboreum*. Chyomi area, lying within the altitudinal range of 2800-3200 m, constituted mainly of Oak-*Rhododendron* forest. The dominant tree species in this site were *Rhododendron arboreum* and *Quercus semecarpifolia*. Tinje area, located within 3200-3600 m altitudinal range, was mostly covered by shrubby vegetation of *Rosa sericea* and *Berberis concinna* with *Rhododendron campanulatum* Kori area, with altitudes from 3700 m to 4000 m, is mostly presenting grasses with scattered *Rhododendron campanulatum*. This area is very sloppy with large rocks cliffs.

Sample collection and identification

Voucher specimens of all vascular plants, either in flowering or fruiting stage, were collected to prepare herbarium specimens (Rajbhandari & Rajbhandary, 2015). All vouchers were taken to the laboratory for identification with the help of detailed field data collected during the field trips. The herbarium specimens were deposited in Tribhuvan University Central Herbarium (TUCH).

Identifications of voucher specimens were carried out by following standard literatures (Grierson & Long, 1983-2001; Polunin & Stainton, 1984; Stainton, 1988; Wu & Raven, 1994; Press et al., 2000; Fraser-Jenkins, 2015; Rajbhandari & Rai, 2017), expert consultation and visit to the National Herbarium and Plant Laboratories (KATH) and Tribhuvan University Central Herbarium (TUCH). Nomenclature follows the Catalogue of Life (Roskov et al., 2019) and Plants of the World Online (POWO, 2019). The plants were classified into different life form following Raunkiaer (1934) (Table 5).

Results and Discussion

Floristic composition

The floristic composition of Sikles region comprised of 295 species belonging to 107 families and 238 genera (Tables 1, 2, 3 and 4). In terms of species, 206 were dicots, 59 monocots, 25 ferns and 5 Gymnosperms (Figure 2). Asteraceae and Rosaceae were dominant families with 18 species each followed by Poaceae (17 species), Orchidaceae (16 species), Ranunculaceae (9 species) and Asparagaceae (8 species). Polygonaceae, Fabaceae, and Lamiaceae (7 species each) were among other families with most species (Figure 3). The present findings are similar to those of Chalise et al. (2019) in Gyasumbdo valley Manang, a territory within Annapurna Conservation Area, where dicots were dominant with Asteraceae as dominant family. However, results differ in monocots, where Orchidaceae was dominant family in Manang, whereas Poaceae was dominant family in the present study. Major parts of the present study area were located in higher altitude mostly covered by the

grasses and with scattered *Rhododendron campanulatum*.

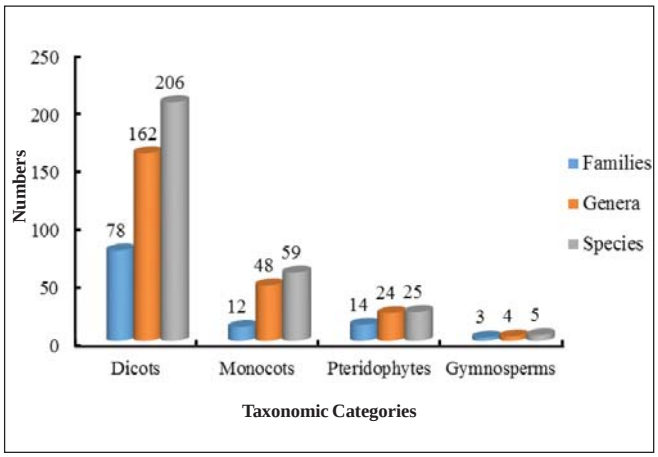

Figure 2: Number of families, genera and species of plant groups

Among 14 families of Pteridophytes, Pteridaceae (3 genera, 5 species) was found to be the largest family, while in case of Gymnosperms, Pinaceae (2 genera, 2 species) was found to be the largest family. Similar results were also reported by Chalise et al. (2019).

Floristic study revealed that dicots (206 species) were the most diverse group followed by monocots (59 species) in terms of species composition. *Impatiens* was the largest genus with 5 species followed by 4 species of *Rubus*. *Begonia*, *Berberis* and *Swertia* had 3 species each. Based on plant habits, 192 (65%) species were herbs, 50 (17%) species were trees and 35 (12%) species were shrubs while climbers included 18 (6%) species (Figure 4).

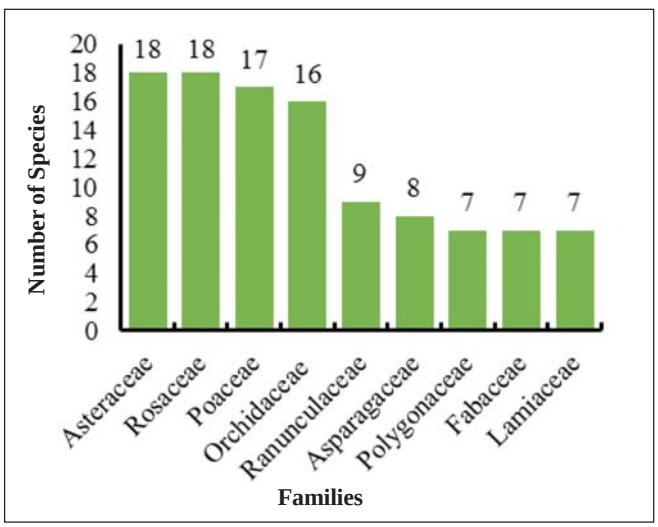

Figure 3: Dominant families in study area

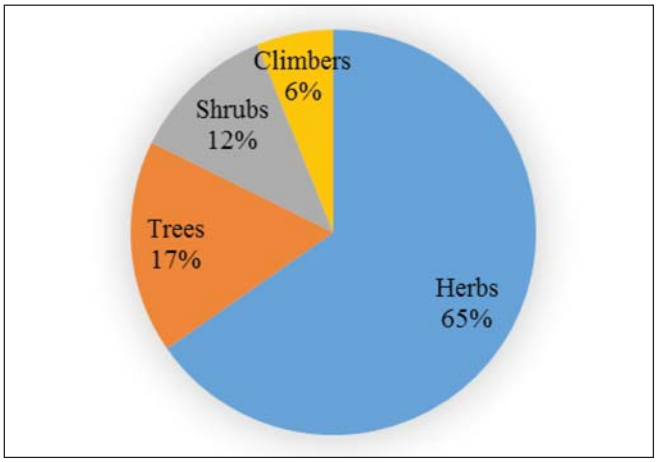

Figure 4: Habits of plants

The study area lies near to Kali Gandaki River which separates the Eastern and Western Himalayan floristic regions. The summer rainfall is high in this area. Therefore, the area is rich with the assemblage of both Eastern and Western floristic elements with some other unique species such as *Alsophila spinulosa*, *Dolomiaea macrocephala*, *Meconopsis regia* and *Hymenidium benthamii*. In the context of the floral diversity, the vegetation is mostly dominated by the Eastern Himalayan elements such as species of *Aconitum*, *Berberis*, *Calanthe*, *Cicerbita*, *Corydalis*, *Potentilla*, *Rubus*, *Saxifraga*, *Delphinium*, and *Impatiens* with other some Western Himalayan elements such as species of *Abies*, *Quercus* (Takhtajan, 1986; Welk, 2015; Chalise et al., 2019). The differing flora of the East Himalaya and the West Himalaya merge in Central Nepal.

Some potentially high value medicinal plants such as *Aconitum gammiei*, *Bergenia ciliata*, *Dactylorhiza hatagirea*, *Paris polyphylla*, *Picrorhiza scrophulariiflora*, *Rheum australe* and *Swertia chirayta* were also recorded. Among the documented species, 17 species had been included in one of the categories of Conservation Assessment and Management Plan (CAMP) (Bhattarai et al., 2002). Two species (*Taxus wallichiana* and *Nardostachys jatamansi* had been included in International Union for Nature Conservation (IUCN) red list categories (IUCN, 2019). Five species had been included in the *Convention on International Trade in Endangered Species* of Wild Fauna and Flora (CITES) list (UNEP-WPMC, 2018). Species such

as *Dactylorhiza hatagirea*, *Picrorhiza scrophulariiflora*, *Swertia chirayta* and *Rubia manjith* which had been included in government list of medicinal plants prioritized for research and development (Gurung & Pyakurel, 2017), were also documented during this study (Table 6).

Life form classes

A total of 283 species were classified based on life forms in different categories (species which identified up to species level). The life form classes showed that phanerophytes (82 species, 29.07%), therophytes (69 species, 25%) and chamaephytes (49 species, 17.37%) were the most abundant life forms. They were followed by cryptophytes (46 species, 16.25%) and hemicryptophytes (37 species, 13.12%) (Figure 5). *Cuscuta reflexa* was the only parasitic species. The life form is an important physiognomic attribute that has been widely used in vegetation studies (Khan et al., 2013). It indicates micro- and macroclimate as well as human disturbance of a particular area. The life form of plant species reflects the adaptation of plants to the climatic conditions (Shah et al., 2013).

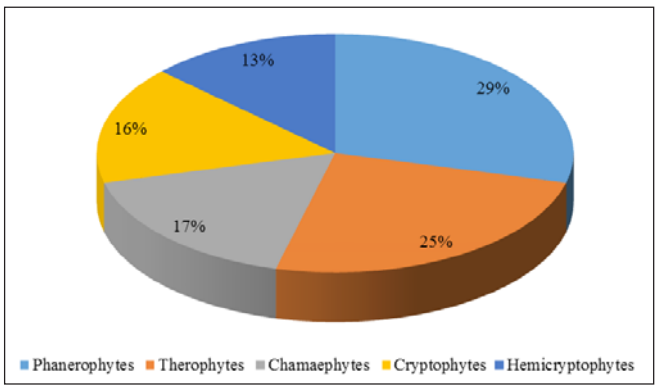

Figure 5: Life-form classes of the flora

The domination of phanerophytes and therophytes over other life forms observed during this study seems to be a response to the topographic divergence, human being and creature disturbance. It also indicates the temperate type (warm and moist) of climate in the study area. The result is contrasting from the study of Joshi et al. (2015) in Nyeshang valley of Manang district within Annapurna Conservation Area where chamaephytes were dominant followed by hemicryptophytes and phenerophytes. Several studies had shown that phanerophytes and therophytes dominance over other life forms might be due to harsh climate and the anthropogenic pressure such as fuel wood collection, grazing, forest fire, lopping and felling of the trees (Khan et al., 2013). Chamaephytes and hemicryptophytes are considered indicators of unfavorable environment and highly vulnerable to any environmental change (Joshi et al., 2015).

Floristic investigations along with life form classification provide reliable information about the nomenclature, distribution, ecology and utility of various plant species. It has been realized that intensive rather than extensive floristic studies of different geographical region are necessary for the proper documentation, conservation plans and sustainable utilization of plant resources (Ali et al., 2018). Due to recurrent forest fires, indiscriminate exploitation of forest resources, destruction of forest areas for construction and introduction of invasive exotic species, several native species are under pressure and may face threat of extinction in future. The description and identification of plants in an area is very important because it shows distinct species in an area and their occurrence in the growing season. Such assessment also helps to identify the ecological vulnerability of the area and to suggest conservation priority (Uprety et al., 2011). It also helps in finding new species of the area and their adjustment in local climatic condition (Ali, 2008).

Conclusion

This study provides fundamental information about the flora of the Sikles region of Annapurna Conservation Area by means of a thorough botanical inventory. Asteraceae and Poaceae were found to be the largest families of dicots and monocots respectively. Likewise, Pinaceae was found to be the largest family of Gymnosperms and Pteridaceae was found to be the largest family of Pteridophytes. The dominance of phanerophytic and therophytic life forms showed that the area was under heavy biotic pressure. These findings could have special significance for further ecological research and for recommendations of proper guidance for the management, reclamation, and development of the

area and other similar regions. Describing the floristic composition of a habitat is valuable for continuation of ecological research, management and conservation of plants. Presence of numerous species of *Aconitum*, *Berberis*, *Delphinium*, *Impatiens*, *Potentilla* and *Saxifraga* represents the dominance of Eastern Himalayan floristic elements.

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Table 1: Dicotyledons

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
1	Acanthaceae	*Achyranthus aspera* L.	KSD391	TH	H
2		*Asystasia macrocarpa* Wall. ex Nees		TH	H
3		*Strobilanthes lachenensis* C. B. Cl.	KSD387	TH	H
4	Acoraceae	*Acorus calamus* L.		CR	H
5	Actinidiaceae	*Saurauia napaulensis* DC.	KSD19	PH	T
6	Adoxaceae	*Viburnum erubescens* Wall.	KSD112	PH	T
7		*Viburnum mullaha* Buch.-Ham. ex D. Don	KSD105	PH	T
8	Amaranthaceae	*Amaranthus spinosus* L.	KSD392	TH	H
9		*Chenopodium album* L.	KSD399	TH	H
10	Anacardiaceae	*Choerospondias axillaris* (Roxb.) B.L. Burtt & A.W. Hill		PH	T
11		*Rhus succedanea* L.	KSD89	PH	T
12	Apiaceae	*Centella asiatica* (L.) Urb.	KSD43	CH	H
13		*Hymenidium benthamii* (Wall. ex DC.) M.G. Pimenov & E. V. Kljuykov	KSD28	CH	H
14		*Cortia depressa* (D. Don) C. Norman	KSD587	HE	H
15		*Selenium* sp.	KSD598		H
16	Apocyanaceae	*Ceropegia pubescens* Wall.		CH	C
17	Aquifoliaceae	*Ilex dipyrena* Wall.	KSD30	PH	T
18	Araliaceae	*Trevesia palmata* (Roxb. ex Lindl.) Vis.	KSD	PH	T
19		*Hedera nepalensis* K. Koch	KSD103	HE	C
20	Asteraceae	*Ageratina adenophora* (Spreng.) R. King & H. Rob.		CH	H
21		*Anaphalis busua* (Buch.-Ham. ex D. Don) DC.	KSD808	CH	H
22		*Anaphalis contorta* (D. Don) Hook. fil.	KSD71	CH	H
23		*Anaphalis triplinervis* (Sims) C. B. Cl.	KSD806	CH	H
24		*Bidens pilosa* L.		TH	H
25		*Cirsium verutum* (D. Don) Spreng.	KSD803	TH	H
26		*Crassocephalum crepidioides* (Benth.) S. Moore.		TH	H
27		*Cremanthodium reniforme* (Wall. ex DC.) Benth.	KSD809	CH	H
28		*Duhalde acappa* (Buch.-Ham. ex D. Don) Pruski & Anderberg	KSD815	PH	S
29		*Senecio graciliflorus* (Wall.) DC.	KSD854	TH	H
30		*Ligularia fischeri* (Ledeb.) Turcz.	KSD824	TH	H
31		*Cicerbita macrorhiza* (Royle) Beauv.	KSD855	TH	H
32		*Pseudognaphalium affine* (D. Don) A. Andeb.	KSD863	TH	H
33		*Dolomiaea macrocephala* Royle		CH	H
34		*Taraxacum officinale* (L.) Weber.	KSD63	TH	H
35		*Ageratum conyzoides* L.		TH	H
36		*Leontopodium stracheyi* (Hook. f.) C. B. Cl. ex Hemsl.	KSD856	CH	H
37		*Artemisia indica* Willd.	KSD05	HE	H
38	Balsaminaceae	*Impatiens edgeworthii* Hook. fil.	KSD781	CH	H
39		*Impatiens racemosa* DC.	KSD782	CH	H
40		*Impatiens* sp.	KSD783		H
41		*Impatiens sulcata* Wall.	KSD784	CH	H
42		*Impatiens urticifolia* Wall.	KSD785	CH	H
43	Begoniaceae	*Begonia dioica* Buch.-Ham. ex D. Don	KSD97	TH	H
44		*Begonia palmata* D. Don	KSD99	TH	H
45		*Begonia picta* Sm.	KSD98	TH	H
46	Berberidaceae	*Berberis aristata* DC.	KSD06	PH	S
47		*Berberis concinna* Hook. fil.	KSD791	PH	S
48		*Berberis napaulensis* (DC.) Spreng.		PH	S
49	Betulaceae	*Alnus nepalensis* D. Don.	KSD07	PH	T

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
50		*Betula utilis* D. Don		PH	T
51	Boraginaceae	*Cynoglossum zeylanicum* (Vahl) Thunb. ex Lehm.	KSD45	TH	H
52		*Cynoglossum* sp.	KSD223		H
53		*Maharanga emodi* (Wall.) A. DC.	KSD107	TH	H
54		*Maharanga bicolor* (Wall.ex G. Don) A. DC.	KSD793	TH	H
55	Campanulaceae	*Lobelia pyramidalis* Wall.	KSD46	TH	H
56	Cannabaceae	*Cannabis sativa* L.	KSD47	CH	S
57	Caprifoliaceae	*Nardostachys jatamansi* (D. Don) DC.		CR	H
58		*Dipsacus inermis* Wall.	KSD786	TH	H
59	Caryophyllaceae	*Stellaria* sp.	KSD788	TH	H
60		*Drymaria cordata* (Blume) J.A. Duke	KSD792	CR	H
61	Celastraceae	*Parnassia nubicola* Wall. ex Royle	KSD797	HE	H
62	Convolvulaceae	*Cuscuta reflexa* Roxb.		P	C
63	Crassulaceae	*Rhodiola bupleuroides* (Wall. ex Hook. fil. &Thoms.) Fu	KSD767	CH	S
64	Cucurbitaceae	*Herpetospermum pedunculosum* (Ser.) C.B. Clarke	KSD675	TH	C
65		*Solena amplexicaulis* (Lam.) Gandhi	KSD48	TH	C
66		*Trichosanthes tricuspidata* Lour.	KSD776	TH	C
67	Daphniphyllaceae	*Daphniphyllum himalayense* (Benth.) Mull. Arg.	KSD772	PH	T
68	Elaeagnaceae	*Elaeagnus infundibularis* Momiy.	KSD11	PH	T
69	Ericaceae	*Lyonia ovalifolia* (Wall.) Drude	KSD13	PH	T
70		*Rhododendron arboreum* Sm.	KSD100	PH	T
71		*Rhododendron campanulatum* D. Don	KSD103	PH	T
72		*Vaccinium nummularia* Hook. Fil & b Thoms. ex C.B. Cl.	KSD101	HE	H
73	Euphorbiaceae	*Euphorbia royleana* Boiss.	KSD768	PH	S
74		*Macaranga denticulata* (Blume) Mull. Arg	KSD762	PH	T
75	Fabaceae	*Parochetus communis* D. Don		TH	H
76		*Erythrina arborescens* Roxb.	KSD761	PH	T
77		*Desmodium elegans* DC.	KSD751	TH	S
78		*Desmodium* sp.	KSD752		S
79		*Crotalaria* sp.	KSD755		H
80		*Piptanthus nepalensis* (Hook.) D.Don	KSD102	PH	S
81		*Indigofera heterantha* Wall. ex Brandis	KSD82	PH	S
82	Fagaceae	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.		PH	T
83		*Quercus galuca* Thunb.	KSD31	PH	T
84		*Quercus semecarpifolia* Sm.	KSD735	PH	T
85	Gentianaceae	*Gentiana depressa* D. Don	KSD388	HE	H
86		*Halenia elliptica* D. Don	KSD70	TH	H
87		*Swertia angustifolia* Buch.-Ham. ex D. Don	KSD51	TH	H
88		*Swertia chirayta* (Roxb.) Karst.	KSD50	HE	H
89		*Swertia paniculata* Wall.	KSD78	TH	H
90		*Gentiana capitata* Buch.-Ham. ex D. Don	KSD65	HE	H
91	Geraniaceae	*Geranium* sp.	KSD731		H
92		*Geranium wallichianum* D. Don ex Sweet	KSD732	CH	H
93	Gesneriaceae	*Aeschynanthus hookeri* C.B. Clarke		TH	H
94		*Chirita pumila* D. Don	KSD736	TH	H
95		*Didymocarpus primulifolius* D. Don	KSD115	TH	H
96	Grossulariaceae	*Ribes himalense* Royle ex Decne.	KSD91	PH	T
97	Hydrangeaceae	*Hydrangea febrifuga* (Lour.) Y. De Smet & Granados	KSD113	TH	S
98		*Hydrangea heteromalla* D. Don	KSD84	PH	T
99	Hypericaceae	*Hypericum elodeoides* Choisy	KSD676	TH	H
100		*Hypericum japonicum* Thunb.	KSD373	TH	H
101		*Hypericum cordifolium* Choisy	KSD273	PH	S

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
102	Juglandaceae	*Juglans regia* L.		PH	T
103		*Engelhardia spicata* Lesch. ex Bl.	KSD731	PH	T
104	Lamiaceae	*Coolebrokea oppositifolia* Sm.	KSD36	PH	S
105		*Leucosceptrum canum* Sm.	KSD32	PH	T
106		*Phlomoides bracteosa* (Royle ex Benth.) Kamelin & Makhm.	KSD724	TH	H
107		*Stachys melissifolia* Benth.	KSD721	TH	H
108		*Elsholtzia blanda* (Benth.) Benth.	KSD66	TH	H
109		*Elsholtzia fruticosa* (D. Don) Rehder	KSD83	PH	S
110		*Colquhounia coccinea* Wall.	KSD805	PH	S
111	Lardizabalaceae	*Stauntonia angustifolia* (Wall.) Christenh.	KSD04	TH	C
112	Lauraceae	*Lindera neesiana* (Wall. ex Nees) Kruz	KSD33	PH	T
113		*Lindera* sp.		PH	T
114		*Cinnamomum tamala* (Buch.-Ham.) Th. G. G. Nees	KSD55	PH	T
115	Linaceae	*Reinwardtia indica* Dumort.	KSD56	PH	S
116	Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre	KSD14	PH	T
117		*Magnolia* sp.	KSD15	PH	T
118	Mazaceae	*Mazus surculosus* D. Don	KSD569	TH	H
119	Melanthiaceae	*Paris polyphylla* Sm.	KSD57	CR	H
120	Melastomataceae	*Osbeckia stellata* Buch.-Ham. ex D. Don	KSD442	PH	H
121	Meliaceae	*Toona ciliata* M. Roem.	KSD802	PH	T
122	Moraceae	*Ficus auriculata* Lour.	KSD87	PH	T
123		*Ficus religiosa* L.		PH	T
124		*Ficus neriifolia* Sm.	KSD719	PH	T
125		*Ficus semicordata* Buch.-Ham. ex Sm.	KSD86	PH	T
126	Myricaceae	*Myrica esculenta* Buch.-Ham. ex D. Don	KSD714	PH	T
127	Oleaceae	*Chrysojasminum fruticans* (L.) Banfi	KSD657	PH	S
128	Onagraceae	*Epilobium brevifolium* D. Don	KSD716	TH	H
129	Orobanchaceae	*Pedicularis siphonantha* D. Don	KSD59	CH	H
130	Oxalidaceae	*Oxalis corniculata* L.	KSD707	CR	H
131	Papaveraceae	*Corydalis juncea* Wall.	KSD706	CH	H
132		*Corydalis* sp.	KSD708	CH	H
133		*Meconopsis paniculatus* (D. Don) Prain	KSD705	CH	H
134		*Meconopsis regia* G. Tayl.		HE	H
135	Pentaphylacaceae	*Eurya acuminata* DC.	KSD35	PH	T
136	Phyllanthaceae	*Phyllanthus parvifolius* Buch.-Ham. ex D. Don	KSD08	PH	S
137	Phytolaccaceae	*Phytolacca acinosa* Roxb.	KSD60	PH	H
138	Piperaceae	*Piper mullesua* Buch.-Ham. ex D. Don	KSD42	TH	C
139	Plantaginaceae	*Plantago major* L.	KSD701	TH	H
140		*Hemipharagma heterophyllum* Wall.	KSD106	CR	H
141		*Picrorhiza scrophulariiflora* (Pennell) D.Y. Hong	KSD61	CR	H
142	Polygonaceae	*Bistorta macrophylla* (D. Don) Sojak	KSD73	CR	H
143		*Fagopyrum acutatum* (Lehm.) Mansf. ex K. Hammer	KSD101	TH	H
144		*Koenigia polystachya* (Wall. ex Meisn.) T.M.Schust. & Reveal	KSD710	CH	H
145		*Rheum acuminatum* Hook. fil. & Thoms.	KSD771	CH	H
146		*Rumex nepalensis* Spreng.	KSD62	CH	H
147		*Rheum australe* D. Don		CH	H
148		*Koenigia mollis* (D. Don) T.M.Schust. & Reveal	KSD76	CH	H
149	Primulaceae	*Maesa chisia* Buch.-Ham. ex D. Don	KSD34	PH	S
150		*Primula denticulata* Sm.	KSD381	TH	H
151	Ranunculaceae	*Anemone rivularis* Buch.-Ham. ex DC.	KSD364	CH	H
152		*Clematis buchananiana* DC.	KSD371	CH	C
153		*Thalictrum reniforme* Wall.	KSD359	CH	H

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
154		*Aconitum spicatum* (Brühl) Stapf	KSD365	TH	H
155		*Aconitum gammiei* Stapf	KSD366	CR	H
156		*Thalictrum foliolosum* DC.	KSD119	CR	H
157		*Delphinium vestitum* Wall.	KSD120	CR	H
158		*Delphinium* sp.	KSD116	CR	H
159		*Ranunculus sceleratus* L.	KSD351	TH	H
160	Rosaceae	*Argentina lineata* (Trevir.) Soják	KSD79	HE	H
161		*Neillia thyrsiflora* D. Don.	KSD94	PH	S
162		*Potentilla* sp.	KSD356		H
163		*Potentilla* sp.	KSD354		H
164		*Prinsepia utilis* Royle	KSD37	PH	S
165		*Pyracantha crenulata* (Roxb. ex D. Don) M.Roemer	KSD26	PH	S
166		*Rubus biflorus* Buch.-Ham. ex Sm.	KSD92	PH	S
167		*Rubus ellipticus* Sm.	KSD87	PH	S
168		*Rubus nepalensis* (Hook. fil.) Kuntze	KSD86	CH	H
169		*Rubus rosifolius* Sm.	KSD88	PH	S
170		*Spiraea bella* Sims.	KSD96	PH	S
171		*Potentilla indica* (Andr.) Wolf	KSD345	HE	H
172		*Fragaria nubicola* Lindl.	KSD344	HE	H
173		*Rosa sericea* Lindl.	KSD336	PH	S
174		*Cotoneaster rotundifolius* Wall. ex Lindley	KSD95	CH	S
175		*Prunus cerasoides* D. Don	KSD16	PH	T
176	Rubiaceae	*Galium elegans* Wall. Ex Roxb.	KSD110	CH	C
177		*Neohymenopogon parasiticus* (Wall.) Bennet	KSD104	PH	S
178		*Rubia manjith* Roxb.	KSD09	TH	C
179	Rutaceae	*Boenninghausenia albiflora* (Hook.) Rchb. ex Meisn.	KSD123	TH	H
180		*Zanthoxylum armatum* DC.	KSD311	PH	T
181		*Zanthoxylum* sp.	KSD315	PH	S
182	Santalaceae	*Pyrularia edulis* (Wall.) A. DC.	KSD317	PH	T
183	Sapindaceae	*Acer cappadocicum* Gled.	KSD38	PH	T
184		*Acer* sp.	KSD328	PH	T
185	Saururaceae	*Houttuynia cordata* Thunb.	KSD122	CR	H
186	Saxifragaceae	*Astilbe rivularis* Buch.-Ham. ex D. Don	KSD121	CH	H
187		*Saxifraga brachypoda* D. Don	KSD318	CH	H
188		*Saxifraga parnassifolia* D. Don	KSD321	CH	H
189		*Bergenia ciliata* (Haw.) Sternb.	KSD324	CR	H
190	Scrophulariaceae	*Buddleja paniculata* Wall.	KSD308	PH	S
191	Simaroubaceae	*Brucea javanica* (L.) Merr.	KSD305	PH	T
192	Solanaceae	*Solanum aculeatissimum* Jacq.	KSD304	TH	H
193		*Solanum nigrum* L.	KSD307	TH	H
194		*Nicotiana tabacum* L.	KSD10	PH	S
195	Symplocaceae	*Symplocos ramosissima* Wall.	KSD17	PH	T
196	Theaceae	*Schima wallichii* Choisy	KSD801	PH	T
197	Thymelaeaceae	*Daphne papyracea* Wall. ex Steud.	KSD03	PH	S
198	Urticaceae	*Boehmeria platyphylla* D. Don	KSD306	CH	H
199		*Elatostema monandrum* (D. Don) H. Hara	KSD303	HE	H
200		*Girardinia diversifolia* (Link) Friis	KSD01	HE	H
201		*Urtica dioca* L.	KSD02	HE	H
202		*Debregeasia salicifolia* (D. Don.) R.	KSD302	PH	S
203		*Pouzolzia sanguinea* (Blume) Merr.	KSD75	HE	H
204	Violaceae	*Viola biflora* L.		HE	H
205		*Viola pilosa* Bl.	KSD64	HE	H
206	Vitaceae	*Tetrastigma serrulatum* (Roxb.) Planch.	KSD63	CH	C

Table 2: Monocotyledons

S.N.	Family	Scientific Name	Collection Number	Life Froms	Habits
1	Amryllidaceae	*Allium wallichii* Kunth	KSD97	CR	H
2	Araceae	*Arisaema costatum* (Wall.) Mart.		CR	H
3		*Arisaema nepenthoides* (Wall.) Mart. ex Schott	KSD80	CR	H
4	Asparagaceae	*Asparagus filicinus* Buch.-Ham. ex D. Don	KSD205	CR	C
5		*Asparagus racemosus* Willd.	KSD20	CR	C
6		*Chlorophytum nepalense* (Lindl.) Baker	KSD114	TH	H
7		*Ophiopogon clarkei* Hook.f.	KSD109	TH	H
8		*Polygonatum cirrhifolium* (Wall.) Royle	KSD21	TH	H
9		*Polygonatum punctatum* Royle ex Kunth	KSD93	TH	H
10		*Maianthemum purpureum* (Wall.) LaFrankie	KSD85	TH	H
11		*Agave cantala* (Haw.) Roxb. ex Salm-Dyck		PH	S
12	Commelinaceae	*Commelina benghalensis* L.	KSD206	CR	H
13	Cyperaceae	*Carex filicina* Nees	KSD208	HE	H
14		*Carex gammiei* (C.B.Clarke) S.R.Zhang & O. Yano	KSD592	HE	H
15		*Carex vesiculosa* Boott	KSD408	HE	H
16		*Cyperus brevifolius (*Rottb.) Hassk.	KSD209	HE	H
17	Dioscoreaceae	*Dioscorea deltoidea* Wall. ex Griseb.	KSD403	CR	C
18		*Dioscorea bulbifera* L.	KSD22	CR	C
19	Juncaceae	*Juncus himalensis* Klotzsch	KSD521	CR	H
20		*Juncus thomsonii* Buch.	KSD215	CR	H
21		*Luzula multiflora* (Retz.) Lej.	KSD211	CR	H
22	Liliaceae	*Cardiocrinum giganteum* (Wall.) Makino		TH	H
23		*Fritillaria cirrhosa* D. Don		CR	H
24	Orchidaceae	*Calanthe tricarinata* Lindl.	KSD216	CR	H
25		*Coelogyne corymbosa* Lindl.	KSD578	CR	H
26		*Coelogyne cristata* Lindl.	KSD77	CR	H
27		*Cymbidium iridioides* D. Don	KSD225	CR	H
28		*Dendrobium porphyrochilum* Lindl.	KSD245	CR	H
29		*Eria coronaria* (Lindl.) Rchb.f.	KSD228	HE	H
30		*Malaxis muscifera* (Lindl.) Kuntze	KSD556	CR	H
31		*Neottia pinetorum* (Lindl.) Szlach.	KSD249	CR	H
32		*Oberonia* sp.			H
33		*Oberonia falcata* King & Pantl.	KSD280	TH	H
34		*Oreorchis micrantha* Lindl.	KSD289	CR	H
35		*Platanthera* sp.	KSD298		H
36		*Pleione humilis* (Sm.) D. Don	KSD584	CR	H
37		*Satyrium nepalense* D. Don	KSD218	CR	H
38		*Dactylorhiza hatagirea* (D. Don) Soó	KSD58	CR	H
39		*Dendrobium amoenum* Wall. ex Lindl.	KSD219	CR	H
40	Poaceae	*Agrostis micrantha* Steud.	KSD231	TH	H
41		*Bromus himalaicus* Stapf	KSD232	TH	H
42		*Chrysopogon gryllus* (L.) Trin.	KSD510	HE	H
43		*Cyrtococcum patens* var. *latifolium* (Honda) Ohwi	KSD234	TH	H
44		*Festuca* sp.	KSD235		H
45		*Isachne albens* Trin.	KSD236	TH	H
46		*Poa infirma* Kunth		TH	H
47		*Setaria plicata* (Lam.) T. Cooke	KSD237	TH	H
48		*Themeda arundinacea* (Roxb.) A.Camus	KSD244	TH	H
49		*Trisetum spicatum* (L.) K.Richt.	KSD555	TH	H
50		*Cynodon dactylon* (L.) Pers.		HE	H
51		*Dendrocalamus hamiltonii* Nees & Arn. Munro		CR	H
52		*Thysanolaena latifolia* (Roxb.) Kuntze		CH	H

S.N.	Family	Scientific Name	Collection Number	Life Froms	Habits
53		*Thamnocalamus spathiflorus* (Trin.) Munro		CH	H
54		*Himalayacalamus brevinodus* Stapleton		CH	H
55		*Eulaliopsis binata* (Retz.) C.E. Hubb.	KSD247	HE	H
56		*Imperata cylindrica* (L.) P. Beauv.	KSD248	HE	H
57	Smilacaceae	*Smilax aspera* L.	KSD27	CR	C
58		*Smilax menispermoidea* A. DC.	KSD241	CR	C
59	Zingiberaceae	*Hedychium spicatum* Sm.	KSD238	CR	H

Table 3: Gymnosperms

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
1	Taxaceae	*Taxus wallichiana* Zucc.	KSD18	PH	T
2	Pinaceae	*Pinus wallichiana* A.B. Jacks	KSD202	PH	T
3		*Abies* sp.		PH	T
4	Cupressaceae	*Juniperus squamata* Buch.-Ham. ex D. Don	KSD29	PH	T
5		*Juniperus recurva* Buch.-Ham. ex D. Don	KSD206	PH	T

Table 4: Pteridophytes

S.N.	Family	Scientific Name	Collection Number	Life Forms	Habits
1	Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	KSD610	CH	H
2	Cyatheaceae	*Alsophila spinulosa* (Wall. ex Hook.) R. M. Tryon		PH	T
3	Dennstaedtiaceae	*Pteridium revolutum* (Bl.) Nakai	KSD612	HE	H
4		*Dennstaedtia appendiculata* (Wall. ex Hook.) J. Sm.	KSD614	CH	H
5	Dryopteridaceae	*Dryopteris barbigera* (Hook.) O. Kuntze	KSD553	HE	H
6		*Polystichum* sp.	KSD604	HE	H
7	Equisetaceae	*Equisetum arvense* L.	KSD615	CR	H
8	Gleicheniaceae	*Dicranopteris linearis* (Brum.fil.) Underw.	KSD609	HE	H
9		*Diplopterygium giganteum* (Wall. ex Hook.) Nakai	KSD607	HE	H
10	Lycopodiaceae	*Palhinhaea cernua* (L.) Carv. Vasc. & Franco	KSD619	CH	C
11		*Phlegmariurus pulcherrimus* (Hook. & Grev.) Löve & Löve	KSD620	CH	H
12		*Lycopodium clavatum* L.	KSD558	CH	H
13	Nephrolepidaceae	*Nephrolepis cordifolia* (L.) Presl	KSD625	CR	H
14	Oleandraceae	*Oleandra wallichii* (Hook.) Presl	KSD623	CR	H
15	Ophioglossaceae	*Ophioglossum reticulatum* L.		TH	H
16		*Japanobotrychum lanuginosum* (Wall. ex Hook. & Grev.) M. Nishida ex Tagawa	KSD621	CR	H
17	Polypodiaceae	*Pyrrosia flocculosa* (D. Don) Ching	KSD635	CH	H
18		*Lepisorus nudus* (Hooker) Ching	KSD634	CH	H
19	Pteridaceae	*Haplopteris taeniophylla* (Copel.) E. H. Crane	KSD630	CH	H
20		*Onychium siliculosum* (Desv.) C. Chr.	KSD631	CH	H
21		*Pteris aspericaulis* Wall. ex Ag.	KSD632	HE	H
22		*Aleuritopteris rufa* (D.Don) Ching	KSD627	HE	H
23		*Pteris* sp.	KSD626	HE	H
24	Selaginellaceae	*Selaginella* sp.	KSD628	HE	H
25	Tectariaceae	*Tectaria coadunata* (J. Smith) C. Christensen		HE	H

Note: Life Froms: PH-Phanerophytes, CH-Chamaephytes, HE-Hemicryptophytes, TH-Therophytes, CR-Cryptophytes, P-Parasite
Habits: C-Climber, H-Herb, S-Shrub, T-Tree

Table 5: Raunkier classification description

S.N.	Life Form	Description
1	**Chamaephytes**	Species with perenating buds born on aerial parts but close to the ground (no more than 25 cm above the soil surface).
2	**Cryptophytes (Geophytes)**	Plant species with buds or shoot apices which survive the unfavorable period below ground or water (species with rhizome, bulb or tuber).
3	**Hemicryptophytes**	All above ground parts of the plant die back in unfavorable conditions and buds are born at ground surface.
4	**Phanerophytes**	Woody species with perenating buds emerging from aerial parts.
5	**Therophytes**	Plant species survive unfavorable condition as seeds (annuals).

Table 6: Prioritized species by different organizations

S.N.	Scientific Name	CAMP	CITES	IUCN	GON/Government Activity
1	*Taxus wallichiana* Zucc.	Endangered	II	Endangered	2
2	*Dolomiaea macrocephala* Royle	Near Threatened			
3	*Maharanga emodi* (Wall.) A. DC.	Data Deficit			
4	*Maharanga bicolor* (Wall.ex G. Don) A. DC.	Data Deficit			
5	*Nardostachys jatamansi* (D. Don) DC.	Vulnerable	II	Critically Endangered	2/ Medicinal Plants for research and development
6	*Swertia angustifolia* Buch.-Ham. ex D. Don	Endangered			
7	*Swertia chirayta* (Roxb.) Karst.	Vulnerable			Medicinal Plants for research and development
8	*Paris polyphylla* Sm	Vulnerable			Medicinal Plants for research and development
9	*Picrorhiza scrophulariiflora* (Pennell) D.Y. Hong	Vulnerable			3/ Medicinal Plants for research and development
10	*Rheum australe* D. Don	Vulnerable			Medicinal Plants for research and development
11	*Aconitum spicatum* (Brühl) Stapf	Vulnerable			Medicinal Plants for research and development
12	*Rubia manjith* Roxb.	Vulnerable			Medicinal Plants for research and development
13	*Arisaema costatum* (Wall.) Mart	Least Concern			
14	*Asparagus racemosus* Willd.	Vulnerable			Medicinal Plants for research and development
15	*Fritillaria cirrhosa* D. Don	Vulnerable			
16	*Dactylorhiza hatagirea* (D. Don) Soó	Endangered	II		1/ Medicinal Plants for research and development
17	*Dioscorea deltoidea* Wall. ex Griseb.	Endangered	II		
18	*Alsophila spinulosa* (Wall. ex Hook.) R. M. Tryon		II		
19	*Zanthoxylum armatum* DC				Medicinal Plants for research and development
20	*Juglans regia* L. (Barks)				1

Note: GoN: Government of Nepal 1= Complete ban: Ban for collection, use, trade, transportation and export, 2= Ban raw export: Banned for export outside the country without processing, 3= Conditional harvesting: The wild harvest and sale allowed only after the taxonomic identification and confirmation of the species as *Picrorhiza scrophulariiflora* Pennell by DPR, and then the final approval of DFO after its inventory and identification of its total natural and harvestable stock in the wild; IUCN: International Union for Nature Conservation; CAMP: Conservation Assessment and Management Plan; CITES: Convention on International Trade in *Endangered Species* of Wild Fauna and Flora