

Floristic Diversity of Vascular Plants in Daman and Adjoining Areas, Makawanpur District, Central Nepal

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Abstract

A systematic investigation of floristic diversity of vascular plants from Daman and the adjoining areas of Makawanpur district, Central Nepal was carried out. The study aimed at identifying the diversity of vascular plants, thus included angiosperms, gymnosperms as well as pteridophytes. Altogether, 136 vascular plant species were documented including 121 angiosperms (98 dicots and 23 monocots), 4 gymnosperms and 11 species of ferns and fern allies. Rosaceae, with 5 genera and 8 species, was found to be the largest family. *Rubus*, with 4 species, was found to be the largest genus followed by *Thalictrum*, *Anaphalis* and *Hypericum* with 3 species each. Among dicots, Rosaceae was found to be the dominant family, whereas Orchidaceae was the dominant family among monocots. Similarly, Pteridaceae was the dominant family of fern and fern allies. Hence, Daman and the adjoining areas of Makawanpur district were observed to be rich in terms of biodiversity and were concluded to serve as important harbors of threatened and protected plant species as well as high value medicinal and aromatic plants.

Keywords: Biodiversity, Orchidaceae, Pteridaceae, Rosaceae, *Rubus*.

Introduction

Biodiversity includes diversity within species and between species, and ecosystems (Chaudhary, 1998). It is not evenly distributed everywhere, rather it varies greatly across the globe as well as within different geographical regions. The Convention on Biological Diversity (1992) defines documentation of the biodiversity as one of the most prioritized tasks by the world. Biodiversity documentation is possible through extensive botanical exploration and floristic studies (Chalise et al., 2018). Floristic study refers to the documentation of all plants species in a given geographical region (Simpson, 2006). Such studies help in botanical enumeration, updating nomenclature changes, adding herbarium specimens in the existing herbaria and comparison of close or distantly related plants (Chalise et al., 2018). The results of such floristic studies mostly come in the form of floras (Palmer et al., 1995) which may be local, regional, country-wise and so on, or they may be in the form of checklists (Chalise et al., 2018).

Nepal is a mountainous country in the Central Himalayas, which occupies about one-third of the entire length of the Himalayan mountain range and

exhibits a unique assemblage of different habitats and a great biodiversity within a small geographical area (Paudel et al., 2011). Nepal lies in a transitional zone between Eastern and Western Himalayan flora (Takhtajan, 1984), thus, is gifted by over 7000 species (Paudel et al., 2011) of vascular plants among which majority are flowering plants. Regarding the history of botanical exploration, Buchanan-Hamilton visited Nepal, especially Central Nepal, from 1802-1803 and collected 433 plant specimens from Makawanpur to Kathmandu along the route. After the establishment of Department of Medicinal Plants in 1960, systematic plant collections were started from Makawanpur by M. S. Bista in collaboration with Japanese botanist H. Kanai during April, 1969 (Joshi, 2014).

Geographically, Makawanpur district lies in the Churia and Mid-Hills of Nepal, and serves as an important hot spot of plant diversity. Joshi (2014) reported 695 angiospermic plant species belonging to 472 genera and 124 families from Makawanpur district while Chapagain et al. (2016) reported a total of 1,045 angiospermic plants belonging to 677 genera and 161 families and 23 gymnosperms belonging to 16 genera and 10 families. Previous

studies have indicated towards the occurrence of rich plant biodiversity in Makawanpur district. Thus, extensive botanical explorations should be carried out in order to document as well as update the biodiversity profile of the area. This study was carried out to document the floristic diversity of vascular plants from Daman and the adjoining areas of Makawanpur district.

Materials and Methods

Study site

Makawanpur district lies in Narayani Zone of Nepal and covers an area of 2,426 km² and with a population of 420,477 (CBS, 2012) and is located about 34 km south of the Capital City- Kathmandu. It was the traditional route connecting Mechi-Mahakali with Kathmandu till Prithvi Highway substituted its role. Out of the total area of this district, 25.15% is cultivable, 2.03% is covered with meadows and bushes, 6.83% is occupied by rivers and their shores, 59.145% is filled with forest, 0.66% is an industrial area while 6.19% is occupied by Conservation Area. It is made up of 75% hilly area and 25% flat lands. The major hill ranges include Chandragiri Hill, Mahabharat Hill and Churia hill ranges. The map of study area is given in Figure 1.

The study area consists mainly of three types of forests i.e Laurel- Oak forest, Pine forest and Mixed broad-leaved forest. Laurel- Oak forest occupies majority of the forest in the study area. In lower parts, Oak forest is associated with *Pinus roxburghii* in some places and with *Juglans regia* in the other places. Common shrubs and small trees are *Sarcococca hookeriana*, *Pieris formosa*, *Lindera pulcherrima*, etc, but in the upper parts, oak trees are associated with *Pinus wallichiana*, *Pyrus* sp. etc. with undergrowth of shrubs and small trees. The pine forest, composed exclusively of *Pinus roxburghii*, occupies the southern slopes of the hill mainly at lower altitude. Here only small trees of *Myrica esculenta*, *Schima wallichii* were noted forming the second layer. The common shrubs are *Berberis asiatica*, *Daphne papyracea*, *Rubus ellipticus*, etc. The broad-leaved forests occur in the northern slopes

of the ridge and consists main component along with *Quercus glauca*. Very few trees of *Rhododendron arboreum* are found in the forest.

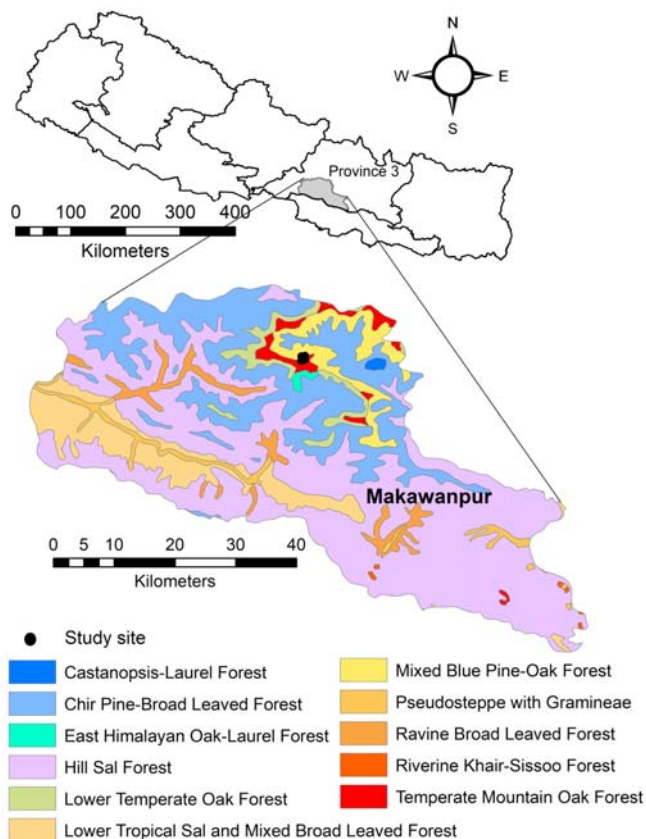


Figure1: Map of Makawanpur district showing different vegetation types in and around the study site.

Methods

Voucher specimens of majority of the vascular plant species, in either flowering or fruiting stage, were collected from the study area during August-September, 2019, especially along the trail from which herbarium specimens were prepared. Identification of those voucher specimens was carried out by following relevant literatures (Grierson & Long, 1983-2001; Polunin & Stainton, 1984; Stainton, 1988; Zheng-Yi et al., 1996-2003; Press et al., 2000; Ohba et al., 2008; Fraser-Jenkins et al., 2015, Chapagain et al., 2016). Identifications were also done by comparing with herbarium specimens at National Herbarium & Plant Laboratories (KATH) and high resolution herbarium images of Herbarium of the University of Tokyo,

Japan (TI) and Herbarium, Royal Botanical Garden, Kew, UK (K). Nomenclature follows the Catalogue of Life (Roskov et al., 2019). The herbarium specimens prepared were deposited at KATH.

Results and Discussion

The present study documented a total of 136 vascular plant species including 121 angiosperms, 4 gymnosperms and 11 species of ferns and fern allies. Altogether, 98 dicotyledonous plants belonging to 85 genera of 49 families were recorded during this study. Similarly, 23 monocotyledonous plants belonging to 23 genera of 11 families, 4 species of gymnosperms belonging to 4 genera of 4 different families and 11 species of fern and fern allies belonging to 10 genera of 4 different families were recorded during this study (Figure 2).

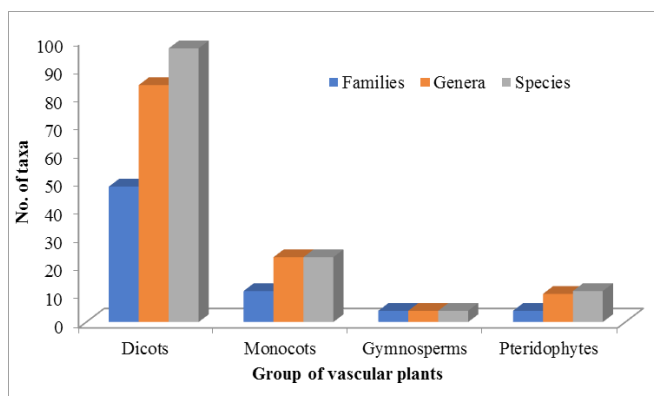


Figure 2: Variation in number of vascular plants in the study area as per the number of families, genera and species.

Rosaceae was the dominant family with eight species belonging to 5 different genera (Figure 3). It was followed by Fabaceae (7 species), Asteraceae (6 species), Ericaceae, Ranunculaceae and Orchidaceae (5 species each), Lamiaceae, Caprifoliaceae, Pteridaceae and Polypodiaceae (4 species each) and so on (Figure 3). However, Joshi (2014) reported, Fabaceae as the largest family of angiosperms in the study area which was followed by Asteraceae.

Comparing the status of dicots as well as monocots, Rosaceae was the dominant family of dicots, whereas Orchidaceae was the dominant family of monocots. Joshi (2014), also reported Orchidaceae as the dominant family of monocots from the study area. Similarly, Pteridaceae was the dominant family of

fern and fern allies. *Rubus* was the dominant genus with 4 different species, which was followed by *Thalictrum*, *Anaphalis* and *Hypericum* with 3 species each and by *Geranium*, *Begonia*, *Impatiens*, *Cyathula* and *Lepisorus* with two species each.

Some of the protected plant species such as *Asparagus racemosus* Willd. (Vulnerable: CAMP), *Bergenia ciliata* (Haw.) Sternb (Rare: CAMP), *Juglans regia* L. (Protected), Orchids viz; *Bulbophyllum* sp., *Calanthe* sp., *Goodyera fusca* (Lindl.) Hook. f, *Satyrium nepalense* D. Don, *Spiranthes sinensis* (Pers.) Ames. (CITES II), *Ceropegia pubescens* Wall. (CITES listed plant), *Rubia manjith* Roxb. (Vulnerable: CAMP), *Swertia chirayita* (Roxb.) H. Karst. (Vulnerable: CAMP), etc. were also recorded during the present study (Shrestha & Shrestha, 2012; Joshi et al., 2017) Sharma et al., 2017; Dhakal & Saud, 2018). Together, some of the high valued medicinal plants such as *Allium wallichii* Kunth., *Asparagus racemosus* Willd., *Swertia chirayita* (Roxb.) H. Karst., *Bergenia ciliate* (Haw.) Sternb, *Astilbe rivularis* Buch.-Ham. ex D. Don, *Valeriana hardwickei*, *Schizotechium monospermum*, *Stauntonia latifolia*, *Phyllanthus parvifolius*, *Chlorophytum nepalense*, *Ophioglossum petiolatum*, *Gaultheria fragrantissima*, etc. were also reported from this study. Joshi (2014) also reported the occurrence of many medicinal and aromatic plants from the study area which, if understood and utilized properly, can provide economic benefit to the local people.

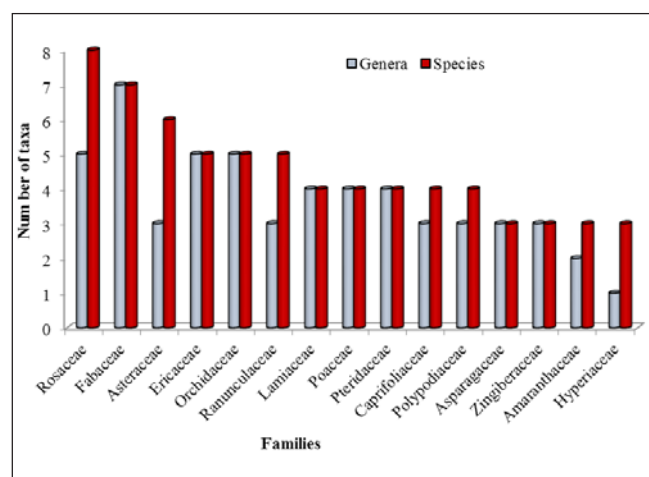


Figure 3: Dominant families of vascular plants in the study area.

Table 1 : List of Angiosperms (Dicots) collected from Daman and adjoining areas of Makawanpur district, Central Nepal

S. N.	Scientific Names	Family	Collection date	Collection No.
1.	<i>Achyranthes aspera</i> L.	Amaranthaceae	-	-
2.	<i>Aeschynanthus hookeri</i> C.B. Clarke	Gesneriaceae	-	-
3.	<i>Ageratina adenophora</i> (Spreng.) R. King and H. Rob.	Asteraceae	-	-
4.	<i>Ainsliaea latifolia</i> (D. Don) Sch. Bip.	Asteraceae	-	-
5.	<i>Alnus nepalensis</i> D. Don	Betulaceae	-	-
6.	<i>Anaphalis contorta</i> (D. Don) Hook.f.	Asteraceae	-	-
7.	<i>Anaphalis margaritacea</i> (L.) Benth. and Hook.f	Asteraceae	2/09/2019	D0063
8.	<i>Anaphalis triplinervis</i> Sims. ex C.B. Clarke.	Asteraceae	2/09/2019	D0057
9.	<i>Astilbe rivularis</i> Buch.-Ham. ex D. Don	Saxifragaceae	1/09/2019	D0044
10.	<i>Begonia dioica</i> Buch.-Ham. ex D. Don	Begoniaceae	-	-
11.	<i>Begonia picta</i> Sm.	Begoniaceae	-	-
12.	<i>Berberis asiatica</i> Roxb. ex DC.	Berberidaceae	-	-
13.	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	-	-
14.	<i>Bistorta amplexicaulis</i> (D. Don) Greene.	Polygonaceae	1/09/2019	D0032
15.	<i>Bupleurum longicaule</i> Wall.	Apiaceae	1/09/2019	D0043
16.	<i>Campanula pallida</i> Wall.	Campanulaceae	1/09/2019	D0028
17.	<i>Ceropegia pubescens</i> Wall.	Apocynaceae	1/09/2019	D0040
18.	<i>Chrysojasminum humile</i> (L.) Banfi	Oleaceae	-	-
19.	<i>Clematis buchananiana</i> DC.	Ranunculaceae	-	-
20.	<i>Clinopodium brosum</i> (M. Bieb.) K. Koch	Lamiaceae	1/09/2019	D0033
21.	<i>Crassula</i> sp.	Crassulaceae	30/08/2019	D0018
22.	<i>Crotolaria albida</i> B. Heyne ex Roth	Fabaceae	1/09/2019	D0027
23.	<i>Cyathula capitata</i> Moq.	Amaranthaceae	-	-
24.	<i>Cyathula tomentosa</i> (Roth) Moq.	Amaranthaceae	-	-
25.	<i>Cynoglossum zeylanicum</i> (Sw. ex Lehm.) Thunb. ex Brand	Boraginaceae	30/08/2019	D0017
26.	<i>Daphne papyracea</i> Wall. ex G. Don	Thymelaeaceae	-	-
27.	<i>Dipsacu sinermis</i> Wall.	Caprifoliaceae	1/09/2019	D0037
28.	<i>Drosera peltata</i> Thunb.	Droseraceae	29/08/2019	D0003
29.	<i>Elsholtzia blanda</i> (Benth.) Benth.	Lamiaceae	-	-
30.	<i>Epilobium wallichianum</i> Hausskn.	Onagraceae	-	-
31.	<i>Eriocapitella vitifolia</i> (Buch.-Ham. ex DC.) Nakai	Ranunculaceae	30/08/2019	D0013
32.	<i>Eurya acuminata</i> DC.	Pentaphragmaceae	3/09/2019	D0075
33.	<i>Galinsoga parviflora</i> Cav.	Asteraceae	-	-
34.	<i>Galium hirtiflorum</i> Req. ex DC.	Rubiaceae	3/09/2019	D0067
35.	<i>Gaultheria fragrantissima</i> Wall.	Ericaceae	2/09/2019	D0054
36.	<i>Gentiana capitata</i> Buch.-Ham. ex D. Don	Gentianaceae	-	-
37.	<i>Geranium donianum</i> Sweet	Geraniaceae	30/08/2019	D0015
38.	<i>Geranium nepalense</i> Sweet	Geraniaceae	-	-
39.	<i>Grona heterocarpa</i> (L.) H. Ohashi and K. Ohashi	Fabaceae	-	-
40.	<i>Hedera nepalensis</i> K. Koch	Araliaceae	-	-
41.	<i>Hemiphragma heterophyllum</i> Wall.	Plantaginaceae	-	-
42.	<i>Henckelia pumila</i> (D. Don) A. Dietr.	Gesneriaceae	-	-
43.	<i>Hydrangea febrifuga</i> (Lour.) Y. De Smet and Granados	Hydrangeaceae	-	-
44.	<i>Hypericum elodeoides</i> Choisy.	Hypericaceae	30/08/2019	D0012
45.	<i>Hypericum</i> sp.	Hypericaceae	1/09/2019	D0029

S. N.	Scientific Names	Family	Collection date	Collection No.
46.	<i>Hypericum uralum</i> Buch.-Ham. ex D. Don	Hypericaceae	2/09/2019	D0061
47.	<i>Impatiens racemosa</i> DC.	Balsaminaceae	3/09/2019	D0070
48.	<i>Impatiens scabrida</i> DC.	Balsaminaceae	31/08/2019	D0024
49.	<i>Indigofera cassioides</i> Rottler ex DC.	Fabaceae	1/09/2019	D0025
50.	<i>Juglans regia</i> L.	Juglandaceae	-	-
51.	<i>Koenigia mollis</i> (D.Don) T.M.Schust. and Reveal	Polygonaceae	1/09/2019	D0038
52.	<i>Lecanthus peduncularis</i> (Royle) Wedd.	Urticaceae	31/08/2019	D0023
53.	<i>Lindera pulcherrima</i> (Nees) Benth. ex Hook.f	Lauraceae	-	-
54.	<i>Litsea</i> sp.	Lauraceae	31/08/2019	D0021
55.	<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	1/09/2019	D0034
56.	<i>Lyonia ovalifolia</i> (Wall.) Drude.	Ericaceae	3/09/2019	D0066
57.	<i>Maesa chisia</i> D.Don	Primulaceae	-	-
58.	<i>Magnolia lanuginosa</i> (Wall.) Figlar and Noot.	Magnoliaceae	29/08/2019	D0001
59.	<i>Myrica esculenta</i> Buch.-Ham. ex D.Don	Myricaceae	-	-
60.	<i>Neohymenopogon parasiticus</i> (Wall.) Bennet	Rubiaceae	3/09/2019	D0069
61.	<i>Oxalis corniculata</i> L.	Oxalidaceae	-	-
62.	<i>Parochetus communis</i> Buch.-Ham. ex D.Don	Fabaceae	-	-
63.	<i>Pedicularis gracilis</i> Wall. ex Benth.	Orobanchaceae	3/09/2019	D0071
64.	<i>Phlomis</i> sp.	Lamiaceae	2/09/2019	D0062
65.	<i>Phyllanthus parvifolius</i> Buch.-Ham. ex D. Don	Euphorbiaceae	1/09/2019	D0039
66.	<i>Pieris formosa</i> (Wall.) D. Don	Ericaceae	3/09/2019	D0065
67.	<i>Pilea</i> sp.	Urticaceae	1/09/2019	D0042
68.	<i>Piptanthus nepalensis</i> (Hook.) Sweet	Fabaceae	-	-
69.	<i>Potentilla fulgens</i> Wall. ex Sims.	Rosaceae	2/09/2019	D0056
70.	<i>Prunella vulgaris</i> L.	Lamiaceae	30/08/2019	D0016
71.	<i>Prunus napaulensis</i> (Ser.) Steud.	Rosaceae	3/09/2019	D0078
72.	<i>Pteracanthus</i> sp.	Acanthaceae	1/09/2019	D0035
73.	<i>Pyrus pashia</i> Buch.-Ham. ex D.Don	Rosaceae	3/09/2019	D0064
74.	<i>Quercus semecarpifolia</i> Sm.	Fagaceae	29/08/2019	D0009
75.	<i>Rhododendron arboretum</i> Sm.	Ericaceae	-	-
76.	<i>Rubia manjith</i> Roxb.	Rubiaceae	-	-
77.	<i>Rubus acuminatus</i> Sm.	Rosaceae	-	-
78.	<i>Rubus ellipticus</i> Sm.	Rosaceae	-	-
79.	<i>Rubus nepalensis</i> (Hook.f.) Kuntze.	Rosaceae	1/09/2019	D0047
80.	<i>Rubus</i> sp.	Rosaceae	2/09/2019	D0053
81.	<i>Schizotechium monospermum</i> (Buch.-Ham. ex D.Don) Pusalkar and S.K.Srivast.	Caryophyllaceae	-	-
82.	<i>Scurrula elata</i> (Edgew.) Danser	Loranthaceae	-	-
83.	<i>Spergula arvensis</i> L.	Caryophyllaceae	29/08/2019	D0006
84.	<i>Spiraea bella</i> Sims.	Rosaceae	31/08/2019	D0022
85.	<i>Stauntonia latifolia</i> (Wall.) R.Br. ex Wall.	Lardizabalaceae	-	-
86.	<i>Strobilanthes</i> sp.	Acanthaceae	-	-
87.	<i>Swertia chirayita</i> (Roxb.) H.Karst.	Gentianaceae	29/08/2019	D0005
88.	<i>Tetrastigma serrulatum</i> (Roxb.) Planch	Vitaceae	-	-
89.	<i>Thalictrum chelidonii</i> DC.	Ranunculaceae	1/09/2019	D0046
90.	<i>Thalictrum cultratum</i> Wall.	Ranunculaceae	29/08/2019	D0007
91.	<i>Thalictrum foliolosum</i> DC.	Ranunculaceae	-	-

S. N.	Scientific Names	Family	Collection date	Collection No.
92.	<i>Trifolium repens</i> L.	Fabaceae	-	-
93.	<i>Vaccinium nummularia</i> Hook.f. and Thomson ex C.B. Clarke	Ericaceae	30/08/2019	D0014
94.	<i>Valeriana hardwickei</i> Wall.	Caprifoliaceae	-	-
95.	<i>Viburnum cylindricum</i> Buch.-Ham. ex D.Don	Caprifoliaceae	3/09/2019	D0068
96.	<i>Vigna munro</i> (L.) Hepper.	Fabaceae	31/08/2019	D0020
97.	<i>Viola biflora</i> L.	Violaceae	-	-
98.	<i>Wikstroemia canescens</i> Meisn.	Thymelaeaceae	2/09/2019	D0058

Table 2 : List of Angiosperms (Monocots)

S. N.	Scientific Names	Family	Collection date	Collection No.
1.	<i>Allium wallichii</i> Kunth.	Amaryllidaceae	2/09/2019	D0060
2.	<i>Arundinella nepalensis</i> Trin.	Poaceae	-	-
3.	<i>Asparagus racemosus</i> Willd.	Asparagaceae	-	-
4.	<i>Bulbophyllum</i> sp.	Orchidaceae	-	-
5.	<i>Calanthe</i> sp.	Orchidaceae	1/09/2019	D0026
6.	<i>Cardiocrinum giganteum</i> (Wall.) Makino	Liliaceae	3/09/2019	D0074
7.	<i>Carex cruciata</i> Wahlenb.	Cyperaceae	-	-
8.	<i>Cautleya spicata</i> (Sm.) Baker	Zingiberaceae	2/09/2019	D0052
9.	<i>Chlorophytum nepalense</i> (Lindl.) Baker	Asparagaceae	-	-
10.	<i>Cyanotis cristata</i> (L.) D.Don	Commelinaceae	3/09/2019	D0073
11.	<i>Elymus</i> sp.	Poaceae	1/09/2019	D0049
12.	<i>Globba clarkei</i> Baker	Zingiberaceae	-	-
13.	<i>Goodyera fusca</i> (Lindl.) Hook.f	Orchidaceae	-	-
14.	<i>Iris</i> sp.	Iridaceae	1/09/2019	D0036
15.	<i>Juncus thomsonii</i> Buchenau.	Juncaceae	1/09/2019	D0030
16.	<i>Lilium nepalense</i> D. Don	Liliaceae	29/08/2019	D0004
17.	<i>Miscanthus nepalensis</i> (Trin.) Hack.	Poaceae	2/09/2019	D0055
18.	<i>Roscoea purpurea</i> Sm.	Zingiberaceae	29/08/2019	D0002
19.	<i>Satyrium nepalense</i> D.Don	Orchidaceae	29/08/2019	D0010
20.	<i>Setaria</i> sp.	Poaceae	-	-
21.	<i>Smilax elegans</i> Wall. ex Kunth.	Smilacaceae	1/09/2019	D0048
22.	<i>Spiranthes sinensis</i> (Pers.) Ames.	Orchidaceae	30/08/2019	D0011
23.	<i>Theropogon pallidus</i> (Wall. ex Kunth) Maxim.	Asparagaceae	-	-

Table 3 : List of Gymnosperms.

S. N.	Scientific Names	Family	Collection date	Collection No.
1.	<i>Pinus wallichiana</i> A. B. Jacks	Pinaceae	2/9/2019	D0059
2.	<i>Thuja orientalis</i> L.	Cupressaceae	-	-
3.	<i>Ginkgo biloba</i> L.	Ginkgoaceae	-	-
4.	<i>Araucaria bidwilli</i> Hook.	Araucariaceae	-	-

Table 4 : List of Pteridophytes.

S. N.	Scientific Names	Family	Collection date	Collection No.
1.	<i>Adiantum tibeticum</i> Ching and Y.X.Lin	Pteridaceae	-	-
2.	<i>Aglaomorpha mollis</i> (Bedd.) Hovenkamp and S.Linds.	Polypodiaceae	-	-
3.	<i>Asplenium</i> sp.	Aspleniaceae	1/09/2019	D0045
4.	<i>Coniogramme</i> sp.	Pteridaceae	3/09/2019	D0072
5.	<i>Dryopteris filix-mas</i> (L.) Schott	Polypodiaceae	-	-
6.	<i>Japanobotrychum lanuginosum</i> (Wall. ex Hook. and Grev.) M. Nishida ex Tagawa	Ophioglossaceae	1/09/2019	D0041
7.	<i>Lepisorus</i> sp.	Polypodiaceae	29/08/2019	D0008
8.	<i>Lepisorus</i> sp.	Polypodiaceae	31/08/2019	D0019
9.	<i>Onychium cryptogrammoides</i> Christ.	Pteridaceae	-	-
10.	<i>Ophioglossum petiolatum</i> Hook.	Ophioglossaceae	-	-
11.	<i>Pteridium</i> sp.	Pteridaceae	1/09/2019	D0051

Conclusion

Heterogenous landscape as well as the climatic variation within short spatial scale make Makawanpur district, especially Daman and the adjoining areas, rich in biodiversity. These divine places not only serve as an important harbor of threatened and protected plant species, but also provide shelter to several high valued medicinal and aromatic plants. Therefore, they have always been the key attraction to the national as well as international researchers and tourists.

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