

IMPACT OF TOURISM ON PLANT DIVERSITY OF DAYARA BUGYAL



Introduction:

Tourism is typically viewed as a help to boost economy. The tourism opens economical opportunities to locals, surrounding that area and provides work to local people of the state. Over the past few decades tourism increased its boundary to international level. There is no debate on the fact that tourism provides sufficient money to the locals by providing employment as well as attracts foreign money to government's revenue, national income and foreign exchange earning. Due to the excessive tourists visit to any tourist place may effect negatively to its surrounding environment. It may have lamentable outcomes on the climate. At the point when tourism dynamic crosses the boundaries of legal and ethical barriers to earn more profit, it can prompt massive degradation of climate nearby. In some ways tourism impact environment adversely. Nearby human population, flora, and fauna, suffers due to such unreliable and unsustainable tourism.

Tourism can have several negative impacts in case of pollution. It increases the noise pollution because of the tourist entertainmant like unwanted yelling by the tourists to entertain themselves and loud music. Which shrink the realised niche of animals present in surrounding area. Tourism can also increase the air pollution by the transportation of travellers.

Pickering and Hill (2007) have reviewed studies on the impact of recreation and tourism on plant biodiversity and vegetation in protected areas in Australia, and found out that vegetation was being crushed, sheared off and uprooted as a result of the nature-based tourism activities. Pickering and Hill further contend that those impacts result in changes to the vegetation including loss of height, biomass, reproductive structures (flowers, fruit, etc.), reduction in cover, increased litter, damage to seedlings and change in species composition. These activities will also lead to changes to the hydrology of the site, soil conditions including nutrients and erosion, as well as the introduction of weeds and pathogen. Tourism can also contribute to the severity of the pathogen's impact by increasing the stress on plants within areas already infected (Buckley et al., 2004).

On the other hand, Newsome et al. (2002), Phillips and Newsome (2002), and Smith and Newsome (2002) posit that the recreation and tourism activities result in root damage to trees

by tethered horses or holes dug by humans or other waste, trees cut for firewood and/or vandalism of vegetation at sites, and wildflowers and epiphytes harvested. According to Kelly et al. (2003) tourism is a threat for 20.8% of the plant taxa in Australia. A more recent study by Ballantyne and Pickering (2013), report that tourism and recreation threatened 42% of the plant species in Europe. The Canary Island and mainland Spain had the greatest diversity of species listed as threatened by tourism and recreation. Liddle (1997) discovered that trampling is by far the most widely studied impact of tourism and recreation on plants. Trampling can reduce biomass, cover, fecundity and survival of individual plant species and sometimes can lead to local extinction of susceptible species. The spread of weed seeds which was carried on tourist vehicles and clothing can threaten the flora species and ecosystem (Wace, 1977; Barker & Wardlaw, 1995). Study by Whinam et al. (2005) found that equipment likely to contain weed seeds included day packs and the cuff and Velcro closures on jackets, although propagules were also found on walking boots. Other form of medium that can spread weed seeds or pathogen include footwear, tent pegs, trowels, horse hooves, bike tyres and other types of vehicles (Buckley et al., 2004). Casual and unpremeditated collecting of plants by tourists can also be a significant threat.

Tourism and Environment are interdependent:

Tourism is based on the environment; Tourism has and will always devour the natural resources. Tourism is the main factor carrying out the natural environment in both positive and negative aspect.

It is understandable that human involvement with environment tend to use the resources, if it can't help to make them grow at least they can be saved from future damages by use of intelligent human behaviour. Study of tourism environment is about understanding the cause and effect rule and to imply theories to protect the environmental loss due to mass tourism. It is also significant that Tourism should place along with the higher quality of environment and environment shall get benefit from it not the damage. No doubt every human action has its own pros and cons and fragility of nature resources must not be seriously harm by it. Tourism is without a doubt among the world's highest profitable industries (whether on the

cost of environment) and relationship between tourism and environment can get equilibrate if financial profits gets used for the conservation programs or environmental sustainability.

Impacts of Tourism on environment:

All activities consume resources and produce waste, possibly all these activities has a potential to spoil the environment, and in same context Tourism is no exception. Tourism has developed as a largest industry and any activity happens at a mass level definitely leaves it's positive and negative impacts, such as tourism did in the past. Although not the case that every environmental problem is produced by tourism but still being a mass industry it affects on a wider platform.

Negative Impacts:

The harmful impact of tourism can destroy the natural environment when the negative impacts on the environment are sufficiently intensive and extensive. Such as damaging biodiversity of particular areas which includes holiday retreats, clearing of vegetation for constructing resorts and hotels or other tourism facilities, and also many rare species have been brought to the verge of disappearance due to non-tourism nuisance which are directly related to tourism. Habitat devastation brought by unrestrained and ill planned tourism is the prime cause of extinction of species which eventually destroy the natural balance, but destruction of biodiversity can have far reaching effects than this. Another negative impact is the depletion of natural resources like water, land and resources like food, energy or raw materials etc. which are already in short supply. Degradation of land resources like wood or plantations is another example of the negative impacts of tourism on the natural environment. Solid waste littering is more common in the case of trekking, rock climbing or hiking tourists. Tourism also pollutes the tourism sites with noise and air pollutions, problems are more compounded in countries or regions which lack or does not have the ability to effectively treat such forms of pollutants generated from tourism activities. Tourism development is more or less responsible for most of the harmful impacts that tourism has on the natural environment. The cutting down of forested

areas, changing the landscape etc all have negative impacts on the ecological balance of the tourism destination, whereas levels of impact may vary from site to site, but the negative impacts of tourism on the environment cannot be ignored. The negative impacts are intensely visible in ecologically fragile environments.

Whether from generating a new site or a heritage site used for different prospective, somehow environment is getting a hard time by this. By pollution, numbers of persons using limited resources, behaviour of tourists while on holidays and so on are some of the causes which directly or indirectly affects environment. It may include both physical and cultural aspects. Unless managing at all level it is difficult to provide specific consideration to each resource and this is how this becomes a negative aspect towards tourism, environment has to pay such cost by loss to the natural settings to beaches, coral reefs or heritage sites.

Effluence caused by tourism main concerns faced by tourism trade today. The sewage waste from tourist resorts are drained into the rivers causing pollution in the river water and eventually to sea bed, it highly affects the marine life. Extreme use of natural resource that is fossil fuel to generate energy for tourist activity, the activities of overfishing, unnecessary use of ground water resources, are only few of problems which are created by tourism industry which in turn causes the reduction of the resource.

As tourism grows, it also give hands to increased littering, various forms of pollution e.g. noise, water, air. Sewage and waste got increased sometimes to uncontrollable levels. Alongside need for transportation gets high and number of vehicles produces numerous gases and noise in air. In areas where resources are limited, tourism develops a sense of competition, leading to all sorts of degradation. Such harmful impacts are majorly brought by poor management or lack of proper conservation mechanism in place.

The term biodiversity or biological diversity refers to the total numbers of individuals and diffrtrent types of living organisms in the ecosystem (Butler, 2006). This includes the terrestrial rainforests, the freshwater lakes, the river systems, the coral reefs, the marine ecosystems and the alpine ecosystem. The loss of biodiversity among other things; threatens

our food supplies, interferes with essential ecological functions, reduces the productivity of ecosystems, and destabilizes and exposes the vulnerability of the ecosystems to natural disasters such as floods, droughts, hurricanes etc. (UNEP, 2014).

Dayara Bugyal is a Bugyal (Himalayan Alpine Meadow) in the Uttarkashi district of Uttarakhand. Dayara Bugyal is a popular Trekking and Camping Destination. The Bugyal has an average elevation of 3639m and is around 40 km from Uttarkashi. Dayara Bugyal is nestled between the Deodar and Rhododendron trees and is rich in flora and fauna.

Dayara Bugyal is also a destination for trekking as well as camping. In spring, there is contrast of greenery of the grasslands and red and pink rhododendrons. In winters, the Bugyal turns into snow land with capability of skiing and snow activities. The trek is open throughout the year except the monsoon. Views of the Garhwal Himalayas, including Nanda devi, Bandar punch and Swargarohini, can be seen from Dayara Bugyal Several plants are present in the bugyal and its surrounding. Few of them are endangered. Due to its natural beauty it is famous around the country and also world wide. Due to the scenic beauty a large amount of tourist visits annually. The current study held to analyse the impact of tourism on the plants diversity as well as the high value medicinal plants.

Methodology:

To assess the impact of tourism in medicinal plants following methods has been applied.

There are two paths to reach Dayara bugyal one from the village Barsu (Less frequent route) and the other one are from Raithal village (More frequent trek). We choose Barsu village to trek to the bugyal and choose another one to trek down. Plant species found on the trek leading to Dayara bugyal were assessed, counted and divided into three main categories rare, common, and abundant. Species were grouped under rare category has less than 100 plant individuals on the path; species were grouped under Common category has under 500 individual count. And species were grouped under abundant category has more than 500 plant individual count.

On Dayara bugyal species status assessed in three different sites lower elevation, medium elevation and higher elevation; and each elevation zone of the bugyal assessed thoroughly and each high medicinal value plants habitat recorded.

Results:

During the trek to Dayara bugyal from Barsu village (less frequent route) total 53 important plant species has been recorded in which *Aquilegia pubiflora*, *Roscoea purpurea*, *Epipectis helleborine*, *Calanthe tricantha*, *Roscoea alpina*, *Podophyllum hexandrum* and *Bergenia ciliata* were found in very less numbers categorised in rare whereas *polygonatum verticillatum* and *viola odorata* found in large amount which is categorised in the abundant category.

During our other trek from Dayara bugyal to the more frequent path to Raithal village total 51 plant species has been recorded and found *Aquilegia pubiflora*, *Roscoea purpurea*, *Epipectis helleborine*, *Smilacina purpurea*, *Berberis chitria*, *Ilex dipyrena*, *Angelica glauca*, *Morina longifolia* and *Rhododendron campanulatum* are in less amount and categorised in rare category whereas *Aconitum spp.*, found in abundant.

Table.1 Biodiversity of plants along the path till Dayara bugyal from Dyari village

S. No	Plant name	Status
1	<i>Swertia sp.</i>	Abundant
2	<i>Viola biflora</i>	Common
3	<i>Viola odorata</i>	Abundant
4	<i>Aquilegia pubiflora</i>	Rare
5	<i>Arisma propinquum</i>	Abundant
6	<i>Arisma jacquemontii</i>	Abundant
7	<i>Peincipia utilis</i>	Common
8	<i>Ajuga brectosa</i>	Common
9	<i>Rubia cordifolia</i>	Abundant
10	<i>Roscoea purpurea</i>	Rare
11	<i>Epipectis helleborine</i>	Rare
12	<i>Carum carvi</i>	Common
13	<i>Varleria wallichii</i>	Rare
14	<i>Calanthe tricantha</i>	Rare
15	<i>Roscoea alpina</i>	Rare
16	<i>Polygonatum verticillatum</i>	Abundant
17	<i>Smilacina purpurea</i>	Common
18	<i>Steroptopus simplex</i>	Rare
19	<i>Smilex elegans</i>	Common
20	<i>Arisaema tortuosum</i>	Common
21	<i>Thalictrum foliosum</i>	Abundant
22	<i>Berberis aristata</i>	Abundant
23	<i>Berberis asiatica</i>	Common
24	<i>Berberis chitria</i>	Rare
25	<i>Podophyllum hexandrum</i>	Rare
26	<i>Corydalis milifolia</i>	Common

27	<i>Silene vulgaris</i>	Common
28	<i>Ilex dipyrena</i>	Common
29	<i>Asculus indica</i>	Common
30	<i>Piptanthus nepalensis</i>	Common
31	<i>Potentilla fulgens</i>	Common
32	<i>Potentilla nepalensis</i>	Abundant
33	<i>Rosa macrophylla</i>	Common
34	<i>Bergenia ciliata</i>	Rare
35	<i>Angelica glauca</i>	Common
36	<i>Pleurospermum brunonis</i>	Common
37	<i>Selinum wallichianum</i>	Common
38	<i>Verbascum grandiflorum</i>	Abundant
39	<i>Morina longifolia</i>	Common
40	<i>Jurina dolomeacea</i>	Common
41	<i>Ligularia sibirica</i>	Common
42	<i>Taraxacum officinale</i>	Abundant
43	<i>Caupamla pallipa</i>	Common
44	<i>Rhododendron arboreum</i>	Common
45	<i>Rhododendron campanulatum</i>	Common
46	<i>Primula denticulata</i>	Abundant
47	<i>Gentiana argatia</i>	Common
48	<i>Liparis rostrata</i>	Rare
49	<i>Quercus leuchotricophora</i>	Abundant
50	<i>Quercus semicarpifolia</i>	Abundant
51	<i>Kashmirica himalayaca</i>	Common
52	<i>Salvia mukrjea</i>	Common
53	<i>Euphobia pilosa</i>	Common

Table.2. Plant diversity along the trek from rethal to Dayara bugyal

S.No.	Plant name	Status
1	<i>Rhododendron campanulatum</i>	Rare
2	<i>Aconitum</i>	Abudant
3	<i>Swertia sp.</i>	Common
4	<i>Viola odorata</i>	Common
5	<i>Aquilegia pubiflora</i>	Abundant
6	<i>Arisma propinquun</i>	Abundant
7	<i>Arisma jacquemontii</i>	Common
8	<i>Peincipia utilis</i>	Common
9	<i>Ajuga brectosa</i>	Common
10	<i>Rubia cordifolia</i>	Abudant
11	<i>Roscoea purpurea</i>	Rare
12	<i>Epipectis helleborine</i>	Rare
13	<i>Carum carvi</i>	Common
14	<i>Calanthe tricantha</i>	Common

15	<i>Roscoea alpina</i>	Common
16	<i>Polygonatum verticillatum</i>	Common
17	<i>Smilacina purpurea</i>	Rare
18	<i>Steroptopus simplex</i>	Common
19	<i>Smilax elegans</i>	Common
20	<i>Arisaema tortuosum</i>	Common
21	<i>Thalictrum foliosum</i>	Abundant
22	<i>Berberis aristata</i>	Common
23	<i>Berberis asiatica</i>	Common
24	<i>Berberis chitria</i>	Rare
25	<i>Podophyllum hexandrum</i>	Common
26	<i>Corydalis milifolia</i>	Common
27	<i>Silene vulgaris</i>	Common
28	<i>Ilex dipyrena</i>	Rare
29	<i>Asculus indica</i>	Common
30	<i>Piptanthus nepalensis</i>	Common
31	<i>Potentilla nepalensis</i>	Common
32	<i>Rosa macrophylla</i>	Common
33	<i>Angelica glauca</i>	Rare
34	<i>Pleurospermum brunonis</i>	Common
35	<i>Selinum wallichianum</i>	Common
36	<i>Verbascum grandiflorum</i>	Abundant
37	<i>Morina longifolia</i>	Rare
38	<i>Jurina dolomeacea</i>	Common
39	<i>Ligularia sibirica</i>	Common
40	<i>Taraxacum officinale</i>	Abundant
41	<i>Caupamla pallipa</i>	Common
42	<i>Rhododendron arboreum</i>	Abundant
43	<i>Rhododendron campanulatum</i>	Rare
44	<i>Primula denticulata</i>	Common
45	<i>Liparis rostrata</i>	Common
46	<i>Buxus wallichiana</i>	Rare
47	<i>Quercus leucotrichophora</i>	Abundant
48	<i>Quercus semicarpifolia</i>	Abundant
49	<i>Kashmira himalayaca</i>	Common
50	<i>Euphorbia pilosa</i>	Rare
51	<i>Epipectis helioborine</i>	Rare













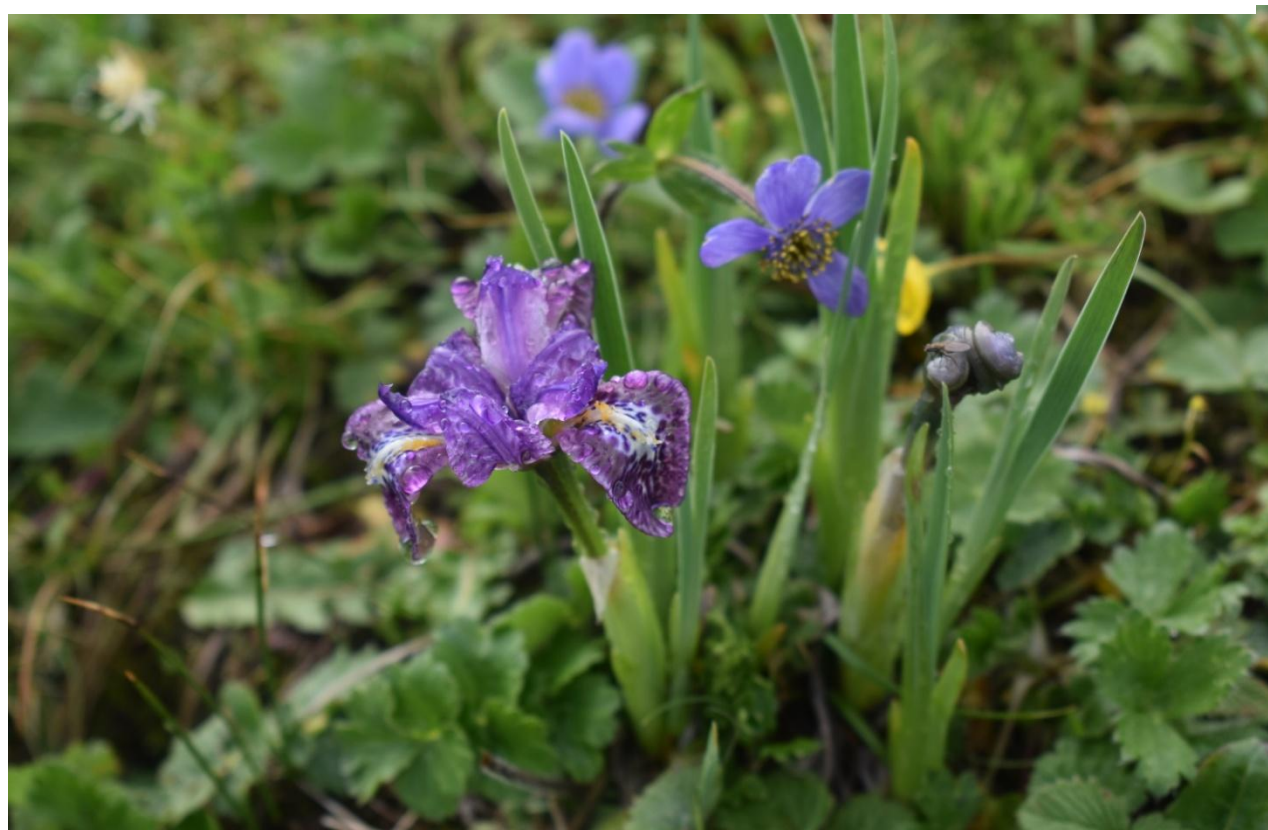
Plants diversity in Dayara bugyal

Total area of Dayara bugyal is divided in three different elevational gradients in which species are divided in main three category. *Arnebia benthammi* and *Bergenia strachyi* are habitat specific plant growing on the rocky/ slopy areas.

Plant name	Lower elevation	Mid elevation	Higher elevation
<i>Nardostachys jatamansi</i>	Common	Common	Rare
<i>Dactylorhiza hatagirea</i>	Common	Rare	Rare
<i>Podophyllum hexandrum</i>	Rare	Rare	Rare
<i>Iris kemaonensis</i>	Abundant	Abundant	Common
<i>Viola biflora</i>	Common	Common	Common
<i>Roscoea alpina</i>	Common	Rare	Rare
<i>Euphorbia pilosa</i>	Abundant	Abundant	Abundant
<i>Corydalis govaniiana</i>	Common	Rare	Rare
<i>Morina longifolia</i>	Abundant	Abundant	Rare
<i>Saussurea roylei</i>	Rare	Rare	Rare
<i>Nomocharis oxypetala</i>	Common	Common	Rare

<i>Carum carvi</i>	Abundant	Abundant	Abundant
<i>Arnebia benthami</i> *	Rare	Rare	Common
<i>Polygonatum verticillatum</i>	Rare	Common	Rare
<i>Smilacina purpurea</i>	Common	Rare	Rare
<i>Viola odorata</i>	Rare	Common	Rare
<i>Thermopsis barbata</i>	Common	Common	Rare
<i>Bergenia stracheyi</i> *	Rare	Common	Rare
<i>Tanacetum dolichophyllum</i>	Common	Common	Common
<i>Allium humile</i>	Rare	Rare	Common
<i>Rhododendron campanulatum</i>	common	Rare	Common

*= plants are habitat specific, growing in rocky areas









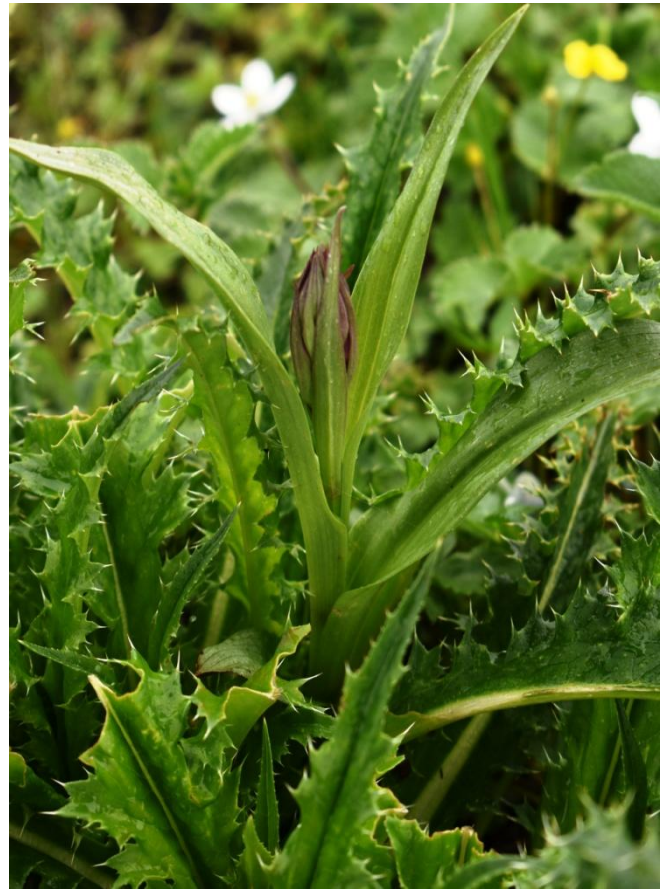
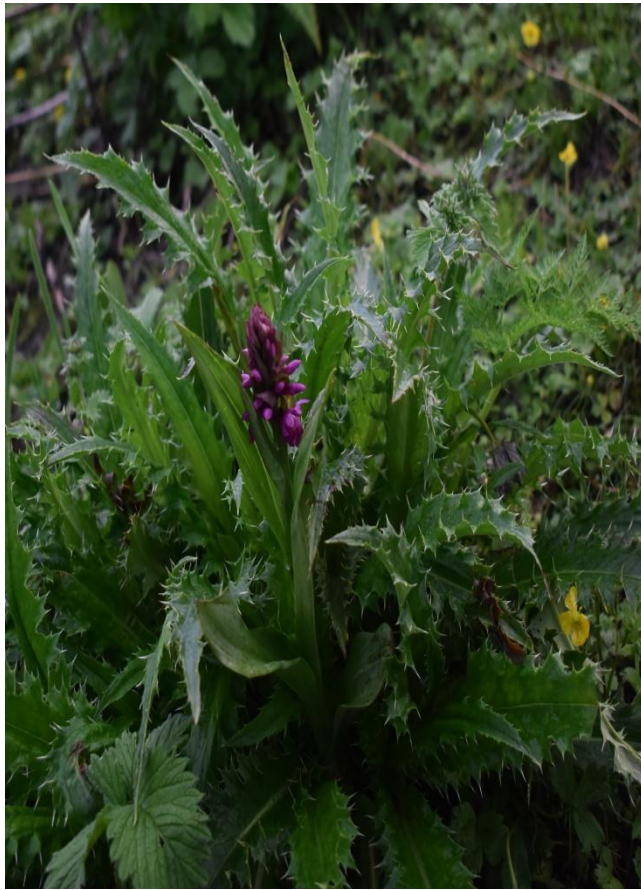
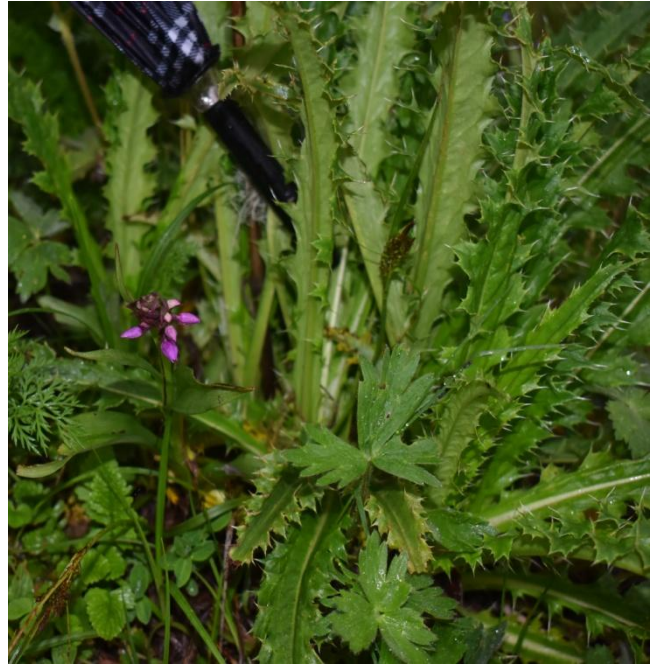
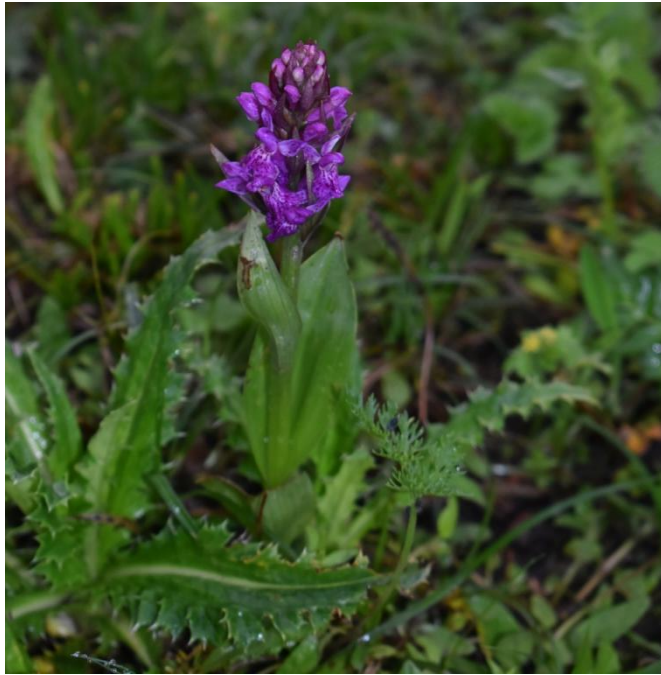




Figs. *Arisaema tortuosum*, *Roscoea alpine*, *Liparis rostrata*, *Swertia sp.*, *Podophyllum hexandrum*, *Polygonatum verticillatum*, *Rhododendron*, *Nardostachys jatamansi*, *Dactylorhiza hatagirea*, *Thermopsis barbata*, *Iris kemaonensis*, *Bergenia strachey*, *Arnebia bentham*, *Allium humile*, *Rhododendron campanulatum*, and *Viola biflora*.

Several factors which may have potential threats to the plants diversity of dayara bugyal and surrounding areas. During the field visit several such cases reported which are mentioned as follows.

- 1. Habitat shifting of *Dactylorhiza hatagirea*:** Many of plants are undergoing large, rapid changes because of human actions. *Dactylorhiza hatagirea* Common in grassy meadows and on slopes of Tirthan, Sainj and Jiwa Nal. Rare in alpine slopes. But in Dayara bugyal most of the plants individuals has been found growing in between the *Morina longifolia* and *Iris kemaounensis*. It may indicate pressure of some anthropogenic activity which is directly correlated to the excessive tourism and grazing of that specific area.



Fig; *Dactylorhiza hatagirea* growing in between *Morina longifolia*.

2. Pollution:

In areas with high concentrations of tourist activities and appealing natural attractions, waste disposal is a serious problem and improper disposal can be a major despoiler of the natural environment - rivers, scenic areas, and roadsides. In mountain areas, trekking tourists generate a great deal of waste. Tourists on expedition leave behind their garbage, oxygen cylinders and even camping equipment. Such practices degrade the environment with all the detritus typical of the developed world, in remote areas that have few garbage collection or disposal facilities.

In the context of pollution if we talk about Dayara bugyal , dust bin installed properly by forest department and cleanliness has been done well. But still, somewhere along the trek we get to see some plastic packets and other non disposable packets.





3. Unwanted breakage of plants:

Travelers have the tendency to pluck beautiful looking flowers. Visitors have no clue about the status of the plant and its rarity; this unwanted breakage and uprooting of plants by the visitors can harm the plants as well as the diversity of that specific plant. Such multiple cases have been reported during the field visit.



4. Plant trampling by using multiple paths:

Tourists using the same trail over and over again and trample the vegetation and soil, eventually causing damage that can lead to loss of biodiversity and other impacts. Such damage can be even more extensive when visitors frequently stray off established trails. Travelers generally use the non permanent short path to shorten the walking distance which is quite often during the trek. By the time this short route becomes permanent and by multiple using this non permanent trek the damaged surrounding flora and economically valuable plant present there can be under serious threat.

Using multiple paths along the permanent trail might be damage the plants diversity of surrounding area. Because during the trek from Basru we have seen multiple short such paths which might damage the plant diversity.





Pic. Multiple short path along the trek

Trampling impacts on vegetation	Trampling impacts on soil
Breakage and bruising of stems	Loss of organic matter
Reduced plant vigor	Reduction in soil macro porosity
Reduced regeneration	Decrease in air and water permeability
Loss of ground cover	Increase in run off
Change in species composition	Accelerated erosion

Other potential threats:

Mountainous areas boast high levels of biodiversity due to the wide variety in topography, weather conditions and traditional land-use practices they embrace. In human-controlled grazing systems, the detrimental or beneficial effects of grazing are largely determined by how and where grazing is used. The negative impacts of livestock grazing are often the result of misuse. The benefits of domestic livestock grazing rarely come by accident, and are likely the result of careful program design, regular monitoring, and flexibility in modifying treatments. The ecological impacts of grazing depend on the type of ecosystem, plant community, and conditions of a particular site (carrying capacity).

Excessive grazing can harm plant composition of the any specific area. So it is important to adopt controlled grazing system. In the case of Dayara bugyal the herd of pet animals can be seen at different areas.





In case of *Dactylorhiza hatagirea* plants growing open areas has been eaten by the cattle feeding around on the area. Which might be a possible threat to its population composition in future?





Fig. Damaged leaves of *Dactylorhiza hatagirea*

Conclusion:

This is a tentative study which is a part of long term monitoring on the impact of tourism on plant diversity. This study reveals that plants diversity found along the busy trek is less than the non conventional trek. Few species like *Aconitum ferox* and *Trillium govani* are found in the busy trek which are absent in other trek.



Fig. Landslide at Dayara bugyal.

Several areas in dayara bugyal are under the land sliding threats which might be due to excessive anthropogenic threats like trekking and excessive grazing. *Dactylorhiza hatagirea* are not found in the open areas and growing between *Morina longifolia* which provides the protective habitat to it. Dayara bugyal is a potential biodiversity hub which can be deduced from the plants found during trekking but the effect of anthropogenic and related pressure put

negative impact. Controlled Ecotourism and awareness programme will definitely control the situation.

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