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## A review on prioritizing conservation of Himalayan medicinal plant species: Case of *Trillium govanianum* (Wall. ex D. Don) kunth

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### Abstract

The Himalayan region harbors rich plant diversity owing to its mountainous topography, altitudinal gradient and climatic conditions. Large number of these plant species is used in healthcare. Collection of such species from nature has been in practice for long time but growing interest in herbal medicines has led to increased demand of these medicinal plants at regional as well as global level that has put this treasure under pressure. Overexploitation of such species from their natural habitats to meet the growing demand has resulted in many plant species facing varying degree of threat to their survival. Medicinal plants inhabiting the alpine and subalpine region of the Himalayas are more vulnerable to such pressure owing to their stressful habitat characteristics and unique regeneration behaviour. *Trillium govanianum* (Wall. ex D. Don) Kunth, locally known as Nagchhatri, is one such highly valuable herb with potent medicinal properties. In recent past the species has come under huge pressure due to its increasing illegal trading. This has been reported for Himachal Pradesh but our exploratory survey in Uttarakhand revealed that collection and trading of the herb is also in practice in the state. The herb is reportedly being traded at current price of Rs. 2500/kg, and almost 30-35 Quintals of the herb has been sold alone from Chamoli district in just three years. Similar information has surfaced from J&K too in some internet blogs. However, no published information of the illegal trading of *T. govanianum* from any state other than H.P. could be found. The herb has been under study in Pakistan, Japan and India for its medicinal activities, origin and genome sequencing etc. but so far no evident work on the regeneration of the herb has been done. Also, different medicinal plant species have been prioritized for conservation but mention of this species could not be found. Therefore, *T. govanianum* is in desperate need of conservation as its natural regeneration capacity is far behind its illegal extraction which can lead to the extinction of the species from nature very soon. Keeping this in view, a study is being undertaken by the authors to determine status of the species in its natural distribution region, reasons for recent upsurge in its demand, magnitude of its collection from nature and devising strategy for its conservation.

**Keywords:** Conservation, demand, illegal exploitation, regeneration, *Trillium govanianum*

### Introduction

Plants are a boon to mankind in many ways. We have been dependent on nature for various needs of our and plant-based medicines/products are one them. Medicinal plants are found in different habitats and with different habits, some of them are annual and biennial while others are perennial. Plants found in the subtropics and tropics are rather in less stressed conditions as compared to plants found in the temperate and alpine ecosystems. The Himalayan region harbors rich plant diversity, in India, the Himalaya covers an area of approximately 591,000 km<sup>2</sup> and lies between 27°50' and 37°06'N and 72°30' and 97°25' E. India is recognized as one of the ten most extensively forested areas in the world because of the Himalaya. Though it covers only 18% of India's geographical area, it accounts for more than 50% of the country's forest cover and 40% of the species endemic to the Indian subcontinent (Saxena *et al.*, 2001) [24]. Plants found in the alpine and temperate regions of the Himalayan tracts are of specific importance since most of them possess some medicinal and aromatic property compared to plants found in other geographical zones growing in less stressful environmental conditions and weather extremities. Several Himalayan alpine and subalpine medicinal and aromatic flora are facing a serious threat as a result of massive and unsystematic extraction to fulfill the needs of the herbal-based pharmaceutical companies. This has resulted in an inevitable and gradual decrease in their population. Since the beginning of civilization, man has always relied

on natural resources and the pressure on nature has always been increasing with the increase in population. As soon as we started understanding the use of herbs to cure an ailment, many plant species have been brought under illegal exploitation since then. Initially, the extraction was in small amounts for local use but now it has increased many folds. A number of plant species have been monitored, studied and listed under various categories ranging from becoming rare, threatened, endangered, and critically endangered to even being extinct in nature. Some of the critically endangered flora now can only be found in the protected areas only while some of them have been brought under cultivation to meet the demands of industries and generation of livelihood. Lots of medicinal plants are under cultivation these days but most of them are of tropical and subtropical origin. Only a very few or a limited number of plants of alpine or temperate origin have been successfully brought under cultivation and this is because of the fact that they thrive in such stressful environmental conditions. And in such situation, if illegal exploitation pertains to meet the demands of the growing herbal industrial sector, their population will keep on declining until they become very rare or extinct in nature.

There are also a large number of species which, for the time being, are considered to be not in a critical situation, *Trillium govanianum* Wall ex. D. Don Kunth locally called as Nagchattri is one such example, although the illegal collection of this plant is piling very high in some Himalayan states of India. Himachal Pradesh government has even imposed a ban on its harvesting from nature but still the extraction goes unabated. The reason behind this can most importantly be the ignorance towards the mention of this species in various research papers on the illegal exploitation and trading of several Himalayan herbs. This species is not officially protected in other Himalayan states and its illegal exploitation affects its population. Several species have been monitored continuously for years and a gradual decrease in their population, size and vitality has been noticed. For instance, large scale exploitation of *Taxus* plants has taken place during 1990s in West Kameng and Tawang districts of Arunachal Pradesh. The interaction with village elders, herders, hunters, local body members, etc. reported that *Taxus* (locally known as Tesiang) was found abundantly in nearby forest surrounding the villages. But, after the largescale supply of leaves, it is now not found within 8 to 10 km radius from the villages. (Nimasow *et al.*, 2015) [15]. Similarly, many other plant species are facing this fate. At least 90% of the plant species used in various herbal industries are extracted from the wild, majority of which comes from the sub-alpine and alpine regions of the Himalaya (Anon, 1997) [3]. The greed to over-harvest the valuable medicinal plants of the Himalaya for immediate cash by selling to any prospective buyer has superseded the traditional values. Though laws have been enacted to prevent over-harvesting, illegal collection is continued across the Himalayan region (Kala, 2002, 2003a) [9]. With escalating competition to collect large quantities of medicinal plants, influential people even hire laborers from outside. The ruthless and unscientific collection of these high value medicinal plants is one of the causal factors for their rarity and making an imbalance in the demand and supply.

From the North West Himalaya, the supply of the few and important rare medicinal plant species, *Dactylorhiza hatagirea*, *Gentiana kurroo*, *Aconitum heterophyllum* and *Picrorhiza kurrooa*, for example, is about 100 tons per year for each species. (Mishra, 1998) [14]. In India, the problem on threatened plants was first discussed in the 11<sup>th</sup> Technical Meeting of the IUCN in 1969 in which important papers were presented on the subject. Subsequently, the Botanical Survey of India published a small book-let: Threatened plants of India- A State-of-the Art Report, in 1980. Valuable base-line data on nearly 1000 threatened species was gathered, all this data had given impetus for writing up of Red Data Books by the Botanical Survey. Endemicity and usefulness leading to overexploitation are the two essential reasons for a species to come under threat. Apart from it, rapid changes in land use have resulted in degradation of specialized natural habitats and of plants confined to these habitats. (Rawat, 2008) [20].

In the recent past, *Trillium govanianum* Wall ex. D. Don Kunth, a medicinally important herb found in the sub alpine moist and shady habitats of the Himalayan region and distributed in the Indian Himalaya, Bhutan, Nepal and China between the elevations range of 2,500 to 4,000 m, has come under huge pressure due to its continuous illicit exploitation.

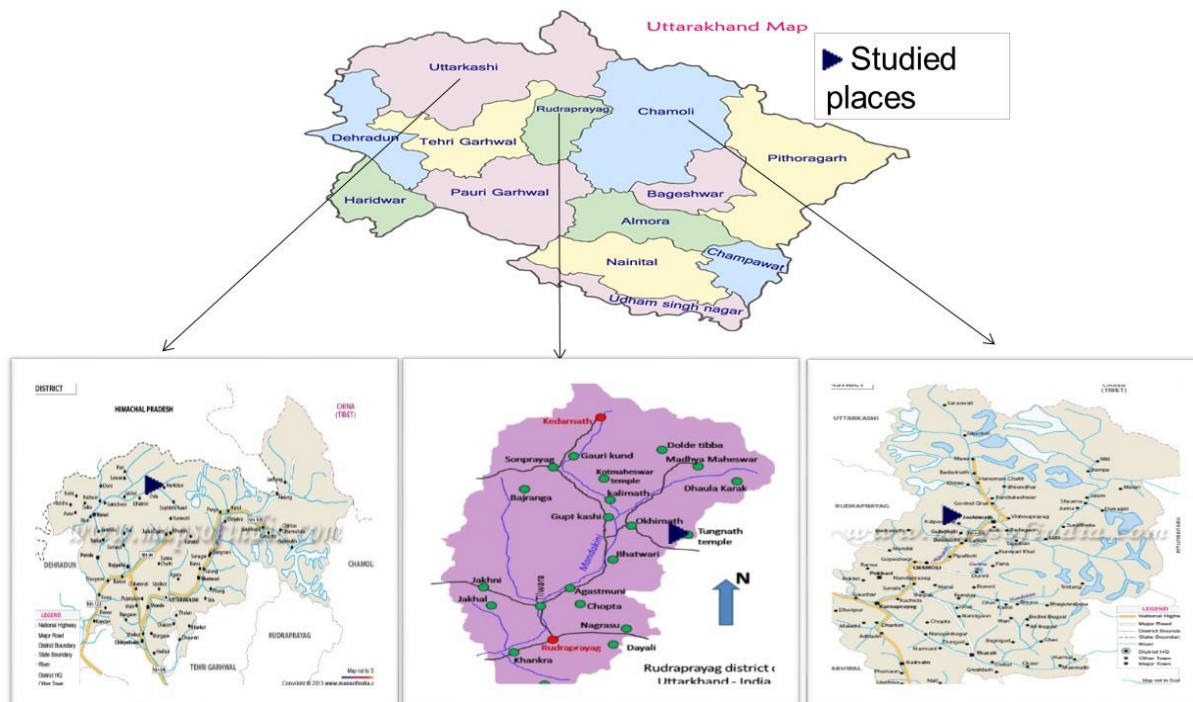
#### **Active content and medicinal uses of *T. govanianum***

The underground part of the plant, i.e. rhizome is key material of trade containing trillaridin which on hydrolysis yield diosgenin and used in preparation of steroidal and sex hormones such as testosterone, glucocorticoids, progesterone. The plant is also reported to have govanoside, a new steroidal saponin, and other components such as borassoside and pennogenin. It is used to cure dysentery, in wound healing, rheumatism, inflammation, sepsis, menstrual and sexual disorders (Pant and Samant, 2010 and Mahmood *et al.*, 2013) [17, 13]. Antioxidant and Anti-cancerous activity has also been reported. (Rahman *et al.*, 2015) [19].

The recent upsurge in the extraction of the herb from nature and its demand has raised serious concern on its sustainability. Since the plant belongs to the sub alpine habitat, it has to survive in stress conditions with fairly less time period to complete its life cycle. Seed formation also declines to a larger extent in this species as a result of early extraction, heavy rainfall, grazing etc. leading to a decrease in its natural regeneration. With the prior reproductive stress and increasing exploitation, the population of the species has declined hugely in several pockets.

#### **Methodology**

Primarily, a detailed literature survey was done on *T. govanianum* owing to its distribution in India, its uses, demand and illegal exploitation. The literature survey was then followed by exploratory field surveys in different pockets of 03 districts of Uttarakhand state viz., Rudrapur (30.4887° N, 79.2170° E), Chamoli (30.5506° N, 79.5660° E) and Uttarkashi (31.1410° N, 78.4155° E). Raw data was collected. Work on regeneration of the herb has been initiated using macro and micro methods at High Altitude Plant Physiology Research Center lab and field stations.



**Fig 1:** Map of the 03 districts and places surveyed.



**Fig 2:** Regeneration studies on the plant at field and lab conditions

### Observations

Through the literature survey it has been found that *Trillium govanianum* is widely distributed in the Indian Himalayas between altitude ranges of 2500 to 4000 m asl but around 2011 its population in nature had started declining to a great extent due to large scale exploitation. According to a study conducted by Vidhyarthi *et al* (2013) [30] in 16 villages of district Kullu, Himanchal Pradesh, it has been reported that *Trillium* was mainly extracted for about 3 months i.e., from June to August before seed setting. It was also found that about 127 ton dried rootstock worth Rs. 13.01 crores was collected by the inhabitants of all the 16 villages. The herb is in high demand in Punjab state. The unabated smuggling of nagchattri (*T. govanianum*) in Himanchal Pradesh, India continues despite the state governments ban in order to save the herb from extinction. About 1235 kg's of illegal herb has been caught by the Chamba and Mandi (within a gap of just 12 days) police in the year 2012. (Anand Bodh, Times of India). The market price of the herb has reached up to Rs 2600 /kg and further increases manifold at the international market.

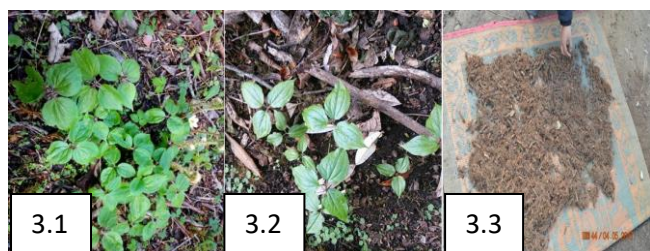
The above information is merely a fragment of the evidence on the illegal trading of *T. govanianum* in India and is only from one state i.e., Himanchal Pradesh. Several publications on threatened plant species since 1990's to 2000 have been lacking the presence of this species. In a study by Uniyal *et al*, (2002) [28] on commercially exploited plants of Kumaon

Himalaya, 14 threatened MAPS (Medicinal and Aromatic Plants) excluding *T. govanianum* have been identified. In yet another publication by Kala C.P (2004) [8], a list of 17 top, second and third priority Himalayan medicinal plants have been given. Although most of the species belong to the habitat similar to *Trillium govanianum*, it has not been mentioned even in the third priority list. The top prioritised group contains five medicinal plants, such as *Aconitum heterophyllum*, *Arnebia benthamii*, *Gloriosa superba*, *Nardostachys grandiflora* and *Podophyllum hexandrum*. Except for *Gloriosa superba*, the rest of the top prioritised species are critically endangered according to the categorization of the World Conservation Union. The second group of prioritised species contains six medicinal plant species such as *Aconitum balfourii*, *Angelica glauca*, *Dactylorhiza hatagirea*, *Fritillaria roylei*, *Meconopsis aculeata* and *Saussurea costus*. The third group of priority species also contains six medicinal plant species, such as *Aconitum falconeri*, *Artemisia maritima*, *Delphinium cashmerianum*, *Picrorhiza kurrooa*, *Thymus linearis* and *Acorus calamus*. In a study on alpine medicinal plant trade and Himalayan mountain livelihood strategies by Olsen and Larsen (2003) [16], there is again no mention of *T. govanianum*. A number of studies e.g., by Ved *et al.*, (2003) [29], Kala *et al.*, (2003) [9, 10], Samant *et al.*, (2007) [21], Siwach *et al.*, (2013) [27], Sharma *et al.*, (2011) [25], Akshay *et al.*, (2014) [1], Shilpa *et al.*, (2015) [26], on the commercialized species of the Himalayan region (HP, Uttarakhand, J&K, Nepal) and their status are further missing the mention of *Trillium govanianum*. Other than HP and Uttarakhand the species is also found in Jammu & Kashmir and is under exploitation there, as stated in some internet blogs, but in a recent study on commercially exploited plants of Jammu & Kashmir conducted in 05 districts, several species has been mentioned again excluding *Trillium govanianum*. (Dar *et al.*, 2017) [6].

In the exploratory surveys done by the authors, information contradictory to the above data has come. Large scale illegal exploitation and smuggling of Nagchattri (*T. govanianum*) not only takes place in Himanchal Pradesh but in Uttarakhand as

well. Although no written evidence so far on the illegal trading of *Trillium govonianum* from Uttarakhand has been published but during a phytosociological survey, it has been found that locals are extracting the herb from nature especially from Distt. Chamoli and Uttarkashi of Uttarakhand. The herb is being traded by the name of Satua or Tipatti in Chamoli and Nagchattri in Uttarkashi at the rate of Rs. 2500-2600/kg.

The species has been under trade in Himachal Pradesh for the past few years and in Uttarakhand from the last 03-04 years. An informant from Chamoli district has stated that around 30-35 Quintals of the herb from wild has been sold during the last 03 years. During the field surveys it has also been observed that the dense and healthy patches of *Trillium govonianum* seen early in the month disappeared up to 95% by the end of the month indicating towards either its illicit collection or some sort of growth pattern.



**Fig 3:** A dense patch of *Trillium govonianum*, 3.2: Same patch after one month, 3.3: Illegally harvested rhizomes of *T. govonianum*

*Trillium govonianum* is a perennial herb with underground rhizomatous structure. It starts emerging in the month of May as soon as the snow melts. Dense patches can be found till the start of monsoon, as soon as the rain starts its population starts declining and gradually by the end of August, finding even 4-5 plants in a single place becomes a difficult task. Since the seeds mature by the end of October, their survival; dispersal and germination is very much less or negligible. Similarly the rhizome suffers transplantation stress when planted for ex-situ conservation and multiplication, giving rise to under-developed plants. Planting the vegetative part in litter and sloppy bed is recommended. Owing to the natural regeneration difficulties and over exploitation the plant is becoming less available in nature. At Uttarkashi we met harvesters/laborers hired to go in far flung places to collect Nagchattri. The harvest is then bought by traders.

In a recent article in Times of India (2016)<sup>[7]</sup> it has been said that Hundreds of people who were camping in the jungles to collect rare Himalayan herbs have returned empty-handed as they failed to find the expensive species which have already been exploited by mafia from particular areas. Prized herb nag chhattri (*Trillium govonianum*) which earned crores of rupees for many people is not being spotted anywhere after hundreds of kilograms of Nagchhattri collected in last few years. Nihani, kadu, van kakdi, gugal and janglilahsun have also disappeared from forests.

### Conclusion

Even after all of this, *T. govonianum* is still not under prioritized category for conservation although it's a very important Himalayan species. The plants are prone to grazing and harsh environmental conditions and its population tends to deteriorate rapidly as a consequence. The stem is succulent type and only three petals are formed in the plant until senescence. *T. govonianum* is being extracted from the natural habitats on a large scale that is a major threat to the species

and should therefore be checked. The herb is in a desperate need of conservation and prioritization since almost 99% of the natural population diminishes before seed set due to harsh environment, grazing, illicit extraction; the multiplication of the plant in nature is mainly by vegetative means. Survival and germination of the fallen seeds is also less and time taking up to 3 years, as reported in other species of *Trillium* (Bown, 1995)<sup>[4]</sup>. There is no limit in the extraction of the herb and it goes beyond its natural regeneration capacity, which has led to a huge decline in its population. The species is under very much threat and it is now high time to take the species under prior consideration and develop conservation strategies for it. Cultivation practice will not only help in sustaining its population but also in earning livelihood.

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