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Uses, Population Status and Management of *Betula utilis*

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Abstract *Betula utilis* is one of the important ethnobotanical species of the Himalayan treeline zone. The outer bark of this tree species has been used historically for writing as well as for making medicines. The multiple historical uses and subsequent overharvesting of *Betula utilis* for meeting the needs of communities and market forces have mounted pressures on its natural populations. The present study, therefore, aims to review and document information on traditional uses, population density and commercial aspects of this valuable tree species. The study further analyses the concerns of conservation and management of this species in view of its importance for ecological, ethnobotanical and economical perspectives.

Keywords: *Betula utilis, treeline zone, himalaya, indigenous uses, population density, conservation and management*

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1. Introduction

The Himalayan birch (*Betula utilis* D. Don), popularly known as Bhojpatra in Indian sub-continent, is one of the most important tree species across the high reaches of the Himalaya. It belongs to family Betulaceae. *Betula utilis* is a medium sized tree, which attains upto 20 m height. It is a multi-branched tree with usually irregular bole. Its shoot, young leaves and bracts are covered with short soft hairs. It has ovate and irregularly serrate leaves, which are deciduous and are arranged in alternate fashion. Its bracts remain broader than the wings of the nut. It flowers during May and June and bears fruits on a spike of lenticular winged nuts [1]. It has reddish-white or white shining bark. Its outer bark has multiple smooth layers, which can be peeled in horizontal flakes. Its inner cortex is reddish.

Betula utilis is a long-lived species, which survives more than 400 years [2]. It helps to maintain the fragile ecosystem of the Himalaya by checking soil erosion and creating bio-shield for rest of the forests and sub-alpine meadows immediately below the treeline zone [3]. Beside multiple ecological benefits, *Betula utilis* has been identified for multiple ethnobotanical importances by different ethnic and non-ethnic communities living in the Himalaya and elsewhere.

The historical uses of *Betula utilis* and subsequent overharvesting for meeting the need of communities and market forces put pressure on its natural populations. With due course of time, this species becomes locally endangered in parts of its distribution range [4]. Since it grows in the high altitude treeline zone, which is inaccessible in most of its range, there are limited studies conducted on its availability in natural habitats and also on the ethnobotanical importance and management. With this background, the present study aims to review and document information on traditional uses, population density and commercial aspects of this valuable tree species. The study further analyses the concerns of conservation and management of this species in view of its importance for ecological, ethnobotanical and economical perspectives.

2. Methodology

Extensive literature survey was undertaken for gathering information on various aspects of *Betula utilis*, which include traditional uses, distribution patterns, population density, regeneration patterns and commercial values. The relevant materials were screened from the dataset by consulting scientific reports, books, book chapters, scientific journals, conference proceedings and online search engines. Besides, the first hand information on traditional uses and traditional conservation practices were also collected and compiled by approaching various ethnic and non-ethnic communities living in the states of Uttarakhand and Himachal Pradesh of India where *Betula utilis* has some good natural populations. The Hindu priests and traditional healers were also interviewed for gathering information on religious and medicinal values of *Betula utilis.*

3. Results and Discussion

3.1 Distribution

In India, *Betula utilis* is generally called as bhojpatra (Figure 1), though it has different names in different

languages for instance, *bhūrja* in Sanskrit, bhurjjamaram in Tamil, bhujapatram in Malayalam, bhujapatri in Telugu and bhuyapathra in Kannada. It grows between 2,500 m to 4,300 m in its distribution range from Nuristan of Afghanistan to Hebei province in northern China. It is native to Afghanistan, Bhutan, China, India, Nepal, Pakistan, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan [4]. In Indian Himalaya, it forms the uppermost part of the natural treeline zone, which generally varies 3300±200m in the northwest to 3800±200 m in the north-eastern region [3]. In the lower altitude (below 3400 m), it is distributed sporadically but in the higher elevation, it has dense and gregarious stands either in pure masses or often with undergrowth of *Rhododendron campanulatum* or with *Abies pindrow*, *Abies spectabilis*, and sometime with Junipers. *Betula utilis* inhabits, generally, on open exposed tracts that remain under snow for 5-6 months during winter [5].

Figure 1. Betula utilis tree

3.2. Uses

3.2.1. Cultural Values

The epithet, *utilis*, itself refers to the number of uses of this important tree species. *Betula utilis* being considered sacred by Hindus it is used in various religious rituals. The outer bark of this species has been in use since time immemorial for writing scriptures and texts, especially in Sanskrit. The outer bark remains the most valuable part of this tree, which is still in use for writing mantras. In anticipation of protecting someone, especially kids, from all misfortunes and receiving blessings an amulet is worn to them containing bark of *Betula utilis* scribbled with mantras. This amulet is worn around the neck or tied around the arm. It is also used in making different Vedic talismans, called as yantras and different yantras are sketched on its papery bark, as well. The collection of papery bark for making such yantras is accomplished in some specific day and time in consideration of specific Nakshatra (lunar mansion in Hindu astrology). This yantra is also believed to provide successful life and prosperity.

At the interval of about 12 years a religious function with pilgrimage is conducted in Chamoli district of Uttarakhand, which is known as the Nanda Devi Raj Jaat Yatra. In this function and pilgrimage, a special umbrella is made for the idol of the Nanda Devi, the local deity. The cover of this umbrella is made up of papery bark of *Betula utilis*. This umbrella is locally called as Nanda's chhatoli. The wood of *Betula utilis* being aromatic it is used in havan (a ritual burning of offerings such as grains and ghee to mark birth, marriage, and other religious prayers).

3.2.2. Medicinal Values

Betula utilis is one of the most important tree species used in various indigenous systems of medicine in India. It is used in tridosa- 'vata' (air), 'pitta' (phlegm) and 'kaph' (cough). Its herbal medicine is prepared in the form of infusion, powder, paste and decoction. Its bark contains betulin and other essential oils those possess medicinal properties. The stem bark is used as styptic, cleaning of wounds and leprosy as it has astringent properties [6,7]. It is also used in obesity. The bark, leaf and resin are used in rheumatism, bone fracture, joint pain, swellings, asthma, and blood purification [8,9]. Its resin is used as contraceptive and treatment of burns and external wounds. The resin is also applied to boils. The bark is used in earache, and also to treat kidney and bladder disorders. It is considered to contain a good therapeutic agent for treatment of psychological disorders and so that it is used in insanity, epilepsy and hysteria. The bark is also used to treat jaundice [10]. The bark is also used in constipation, cough and as a tonic [11]. The infusion of bark is used in relieving flatulence [5]. The bark is also used for treatment of domestic animals. The bark is burnt to ashes and its paste is applied on the deep cuts and wounds of animals [9].

The scientific validation of traditional uses of *Betula utilis* reveals that it contains anti-infective agent, which is bactericidal [12]. The bark is further validated for containing significant antioxidant activity and high amount of palmitic, linoleic and oleic acid, which possess nutraceutical and pharmaceutical applications [11]. Of the six triterpenes namely betulin, betulinic acid, lupeol, oleanolic acid, ursolic acid and β-amyrin isolated from *Betula utilis*, the ursolic acid possesses effective tumour cell specific cytotoxic property, which determines its therapeutic potential against breast cancer [13].

3.2.3. Other Uses

The local people of its distribution range, traditionally, have been using *Betula utilis* as a valuable timber for construction of houses and making local bridges. It has hard and dense wood. The high altitude pastoral communities use its wood for firewood and construction of huts during their stay in the high altitude of the Himalaya. The papery bark of *Betula utilis* is also used for making roof top and umbrella cover by these communities [14]. The leaves are used for fodder and so that the branches are lopped for collection of leaves. The papery bark is used as plates. Betulin extracted from bark is also used for esterification (making an ester as the product after the chemical reaction of an alcohol and an acid) of rosin, which is considered superior to other ester gums [5].

This species helps to bind soil in its natural habitat, which is mainly the high altitude mountain slope. Being an upper most treeline species, it functions as bio-shield and helps to maintain the sub-alpine forests from destruction during heavy snowfall and avalanches. The forest of *Betula utilis* is prominent habited of many

wild animals and birds, including musk deer, Himalayan black bear and pheasants like Himalayan monal. Besides, it provides fodder to high altitude wild herbivores. *Betula utilis* trees are also used for ornamental purpose and beautification of landscape. Being a long lived tree species, at present, it is being used for understating dendroclimatology by establishing its relationships with climate and glacial fluctuations [15].

3.3. Population Density and Regeneration

There are variations in population densities of *Betula utilis* across the altitudinal and geographical range. Generally, the population density of *Betula utilis* increases with elevation in its known geographical range. The density of *Betula utilis* is estimated minimum in temperate forests of Dhauladhar mountain range below 3000 m in Himachal Pradesh of India whereas the maximum density is recorded between 3800-4000 m in Samagaun valley of Gorkha district in Central Nepal. However, within Dhauladhar mountain range, the density increases with altitude and it becomes significantly higher in sub-alpine forests above 3000 m. The density of *Betula utilis* is relatively higher in sub-alpine forests of Uttarakhand than the adjacent state of Himachal Pradesh (Table 1).

The regeneration of *Betula utilis*, in terms of seedling and sapling density, is estimated lowest in temperate forests of Dhauladhar mountain range below 3000 m in Himachal Pradesh whereas it is recorded highest for mixed forests (between 3500-3900 m) in Manang district of Central Nepal. There are locality specific variations in regeneration patterns of *Betula utilis*. Within Samagaun valley in Nepal, the density of seedlings and saplings of *Betula utilis* is higher in mixed forests between 3500 - 3800 m than the pure *Betula utilis* forests between 3800-4000 m. The similar pattern is reported within Manang district of Nepal between mixed forests (3500-3900 m), and pure *Betula utilis* forests (3900-4200 m). The seedling and sapling density of *Betula utilis* is higher in sub-alpine forests of Uttarakhand than the Himachal Pradesh (Table 2).

Table 1. Population density of *Betula utilis* in different localities of its distribution range

Locality	Density (per ha)	Reference
Dhauladhar mountain (below 3000 m; Temperate forests), Himachal Pradesh, India	8.21	Sharma, 2017 [9]; Sharma and Kala, 2018 [22]
Dhauladhar mountain (above 3000 m; Sub-alpine forests), Himachal Pradesh, India	131.43	Sharma, 2017 [9]; Sharma and Kala, 2018 [22]
Mixed forest (3500-3800 m), Samagaun valley, Gorkha district, Central Nepal	1384	Sujakhu et al., 2013 [23]
Pure Betula forests (3800-4000 m), Samagaun valley, Gorkha district, Central Nepal	1654	Sujakhu et al., 2013 [23]
Mixed forest (3500-3900 m), Manang district, Central Nepal	864	Shrestha et al., 2007 [24]
Pure Betula forests (3900-4200 m), Manang district, Central Nepal	1207	Shrestha et al., 2007 [24]
Moist upper temperate forests (2550-3000 m), Bhyundar valley, Uttarakhand	11.67	Kala, 2004 [14]
Sub-alpine fir forests (3000-3300 m), Bhyundar valley, Uttarakhand	27.03	Kala, 2004 [14]
Sub-alpine birch forests (3300-3600 m), Bhyundar valley, Uttarakhand	287.96	Kala, 2004 [14]

Table 2. Regeneration (seedling and sapling density) of *Betula utilis* in different localities of its distribution range

Locality	Seedling density (per ha)	Sapling density (per ha)	Reference
Dhauladhar mountain (below 3000 m; Temperate forests), Himachal Pradesh, India	8	12	Sharma, 2017 [9]
Dhauladhar mountain (above 3000 m; Sub-alpine forests), Himachal Pradesh, India	60	77	Sharma, 2017 [9]
Mixed forest (3500-3800 m), Samagaun valley, Gorkha district, Central Nepal	156	1136	Sujakhu et al., 2013 [23]
Pure Betula forests (3800-4000 m), Samagaun valley, Gorkha district, Central Nepal	33	147	Sujakhu et al., 2013 [23]
Mixed forest (3500-3900 m), Manang district, Central Nepal	408	1724	Shrestha et al., 2007 [24]
Pure Betula forests (3900-4200 m), Manang district, Central Nepal	373	913	Shrestha et al., 2007 [24]
Gulmarg (South West), Jammu-Kashmir	531-1031	260-558	Mir et al., 2017 [25]
Sonamarg (South West), Jammu-Kashmir	656-1368	259-554	Mir et al., 2017 [25]
Sonamarg (South East), Jammu-Kashmir	594-1375	225-532	Mir et al., 2017 [25]
Sub-alpine fir forests (3000-3300 m), Bhyundar valley, Uttarakhand	NA	16	Kala, 2004 [14]
Sub-alpine birch forests (3300-3600 m), Bhyundar valley, Uttarakhand	NA	770	Kala, 2004 [14]

3.4. Trade

The papery bark of *Betula utilis* is being sold in the market. The cost of its crude bark at Haridwar city of Uttarakhand is Rupees 1200 per kg [16]. It is also sold through online market system on Amazon, Indiamart and other websites. The cost of 5 pieces of Bhojpatra Sheet (5×5 inches of papery bark) is Rupees 176 at Amazon. In international market, the cost goes upto Rupees 900 for 3 pieces of its 9×9 inches of papery bark sheet [17]. The cost of yantras prepared by using its papery bark goes higher than the papery bark alone. The cost of one such yantra, called as 'Sri Maha Mrityunjaya Yantra on Bhojpatra', is Rupees 1550, as it is believed to be one of the powerful yantras [18].

3.5. Management and Conservation

Betula utilis being a multipurpose tree species, it has been exploited since time immemorial. To protect and regulate its over-exploitation, historically, the ethno-conservationists might have associated this species with religion. The traditional herbal healers and Hindu priests, usually, collect the required plant parts at particular season and discourage others who do not follow the customary norms of its collection. They also chant some mantras while collecting its parts for religious or medicinal purpose. They also avoid disclosing the medicinal properties of this tree species. While passing the knowledge to their disciple they preach them not to misuse the knowledge and the species. This leads to pay respect for the species, which helps in its conservation [19].

At present, there is pressure on the existing populations of this species due to its over-collection from specific localities. For instance, in Gangotri region of Uttarakhand, the high number of pilgrims while collecting Ganges water also debark *Betula utilis* for collection of its papery bark. There is a place in Gangotri which is named as Bhojbhasa because it had a good population of *Betula utilis*, in the recent past. But over the years of repeated over-exploitation of *Betula utilis* for fuelwood and other purposes from Bhojbhasa has made to decline its population. There are reports on massive deforestation and over-exploitation of *Betula utilis* trees from the entire Himalayan range that has caused reduction of its native groves and deterioration of habitats [20]. In Mankial Valley of Hindukush Range, about 85% of its population has decreased and now it remains in very few localities within this valley [4]. Realizing the decline in its population, it has been placed under threatened category. However, the threat categories assigned to this species vary in different countries and within different states of a same country. For instance, it is assigned the status of Critically Endangered for Jammu and Kashmir within India [21], but it is under Least Concern category in China [4].

4. Conclusion

Historically, *Betula utilis* has been used for number of ethnobotanical purposes, which include religious and medicinal. It grows in the upper treeline zone of the Himalaya where it acts as a bio-shield along with *Rhododendron campanulatum*. The papery bark of *Betula utilis* has good demand hence it is being sold in the market. Being an important source of medicine, various useful plant parts of *Betula utilis* should be screened properly for making standardized herbal drugs. At the same time, collection of this tree species needs to be regulated for its sustained availability and conservation of fragile Himalayan ecosystem. Besides in-situ conservation, this species needs to be planted in its natural habitats by raising nurseries. The bio-technological tools may be applied for large scale propagation of this important tree species. At the same time, the spiritual connection may be utilized for bringing traditional institutions together for saving this species.

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