**Protected Groves of Garhwal Himalaya,** **India: Biodiversity Status and Strategies for their Conservation**

Tapendra Singh Bisht1, Radha Ballabha1 and A. B. Bhatt1

1Department of Botany, HNB Garhwal University, Srinagar Garhwal, Uttarakhand- 246 174, India

Authors E-mail: tapi\_bisht06@ yahoo.co.in,radhekuniyal.2007@rediffmail.com

Abstract: The people of Garhwal, a part of central Himalaya, follow ancestral worship and animism in the form of deity worship, with the central focus on worship in forest patches. These social boundaries help to conserve the entire organisms as a whole, which stand the concept of sacred or protected groves. The pleasing of deities is performed every year by the villagers around the sacred groves, in honour of the deities and to gain their favour. Indigenous cultural and rituals practices of the local people in sacred groves serve as a tool for conserving biodiversity. Protected or sacred groves are distributed over a wide ecosystem and help in conservation of rare and endemic species. Well-preserved protected groves are store houses of valuable medicinal and other plants having high economic value, and serve as a refuge to threatened species. Thirty sacred and protected groves were inventoried in six districts of Garhwal Himalaya. Detailed studies were carried out in four selected groves, to understand the importance of biodiversity status and vegetation characteristics. A total of 271 plant species representing 211 genera under 88 families were recorded through baseline floristic survey. The species diversity indices were compared among the four studied groves. The vegetation composition and community characteristics were recorded. Ethnobotanical uses of species were examined, which reveal that 90% of species were used as medicine for the treatment of various ailments. A few of the medicinal plants which have disappeared from the locality are now confined only to the groves. Socio- cultural aspects were investigated taking into account the attitudes of local people, which indicates social beliefs and taboo are eroding simultaneously degrading the degree of protection of sacred and protected groves. Therefore, conservation measures of protected groves need to be formulated considering the factor of degradation and the basic necessities of the local people. Until and unless a viable option is provided to the local people for sustaining their economic condition, no step for conservation of biodiversity will be successful. [Journal of American Science 2010;x(x):xx-xx]. (ISSN: 1545-1003).

**Keywords:** Garhwal Himalaya, Protected groves, Biodiversity value, Conservation status.

**1. Introduction**

In India as elsewhere in many parts of world a number of communities practice different form of nature worship. One significant tradition of nature worship is that of providing protection to patches of forest dedicated to deities or ancestral sprits. These patches of forests are known as sacred or protected groves. The institution of sacred groves is very ancient and once was widespread in most parts of the world with over 50,000 sacred groves so far reported from different parts of India. Sacred groves are the rich heritage of India, and play an important role in the religious and socio cultural life of the local people. Sacred groves are ecosystems by themselves and perform all the ecological function. Many threatened endangered, and rare species find safe refuge in the sacred groves. Himalaya has been a perennial source of attraction, curiosity and challenge to human intellect throughout the ages. Uttarakhand possesses luxuriant and varied vegetation within the Himalayan region. Almost every plant has economic importance from either a nutritional, aesthetic or medicinal viewpoint. In fact, large percentage of crude drugs in the Indian market comes from this Himalayan area (Badoni 1990). Nearly thirty species from the Garhwal Himalaya have been listed in various categories under threat in the Indian Red Data Book (Nayar and Sastry, 1987, 1988 and 1990) of which 24 species are from high altitude alpine region.

Garhwal Himalaya in India commonly referred to as Dev Bhumi (land of the Gods) houses many important religious shrines like Badrinath, Kedarnath, Yamanotri and Gangotri etc. besides the sacred confluence of five tributaries of holy Ganga. It is interesting to note here that many a time an entire landscape represented by a variety of species and ecosystems had been considered sacred or protected and conserved as such in pristine condition by forbidding the use of any resource from it. This strategy seems to be quite analogous to the present day’s concept of species conservation through sanctuaries, national parks and biosphere reserves. The examples of forest community conservation are the well known Chipko, Raksha Sutra and Maity movements. These are among the pioneer social movements towards the conservation and regional environment initiated in the Central Himalaya. All these movements had one common objectives i.e., to conserve the serenity of the environment by maintaining the natural forest wealth. The Chipko and Raksha Sutra were aimed to prevent the forests by deforestation while Maity movement aimed to raise new forest through plantation programs. Many traditional societies all over the world revered and worshipped nature and considered certain plants and animals as sacred. Some communities also followed the practice of setting aside certain patches of land or forest as "sacred groves" dedicated to a deity or village God, protected and worshipped. In India sacred groves are found all over the country and abundantly along the Western Ghats and the West coast and in several parts of Kerala, Karnataka, Tamil Nadu, Maharashtra, Madhya Pradesh, Rajasthan, Orissa and Himachal Pradesh.

Sacred groves in different states are locally known by different names. In Kerala there are hundreds of small jungles dedicated to snakes called Sarpakavu (sarpa meaning snake and kavu meaning jungle). There are the Ayyappan kavus dedicated to Lord Ayyapan, the most famous of which is Sabarimala, visited by millions of devotees every year. These areas have protected many rare and endangered species, including valuable medicinal plants. In Maharashtra, the sacred groves are known as deonus and are found in the Western Ghats region. Known as samas in Bihar, such groves are seen in the Chotanagpur regions, established by the Munda tribe as abodes of their godly spirits. In the arid regions of Rajasthan there are many sacred groves, variously called as Oraans, Vanis, and Kenking. The Bishnois of Rajasthan have also been responsible for preserving the habitats of the Khejadi tree (*Prosopis cineraria*).

The role of sacred groves in the conservation of biodiversity has long been recognized (Kosambi, 1962; Gadgil and Vartak, 1976; Haridasan and Rao, 1985; Khan *et al.* 1997). All forms of vegetation in the sacred groves are supposed to be under the protection of the reigning deity of that grove, and the removal of even a small twig is taboo (Vartak and Gadgil, 1973). It is believed that sacred virgin forests date back to several thousands of years when human society was in the primitive state. Gadgil and Vartak (1973) have traced this historical link of the sacred groves to the pre-agricultural, hunting and gathering societies. Hughes and Chandran (1997) have presented an overview on the distribution of sacred groves around the earth in Asia, Africa, Australia, Europe and America.

In India, the earliest documented work on sacred groves is that of the first Inspector General of Forests, Brandis (1897). Burman (1992) has reported the existence of sacred groves all along the Himalaya from the northwest to northeast, western Himalaya of Kumaun and Garhwal, Darjeeling and Meghalaya. Ramakrishnan (1996) also identified sacred groves from different parts of India, known by different names given to them in ethnic terms. Many scholars have been working on conservation of sacred groves through socio-cultural practices in different parts of India (Gadgil and Vartak, 1975; Boojh and Ramakrishnan, 1983; Rodgers, 1994; King, 1997; Tiwari *et al.*, 1998; Sinha and Maikhuri, 1998.

However, little information is available on protected groves and conservation of the biodiversity of Garhwal Himalaya, in Uttarakhand. People of Garhwal follow ancestral worship and animism in the form of deity worship, with the central focus of worship on forest patches which signify protected or sacred groves. The area of protected groves range from a few square meters to several hectares situated in different altitudinal gradients and natural ecosystems which helps in conservation of biodiversity. But unfortunately, due to population explosion, various encroachment and activities, protected groves have also become the victim of encroachment and exploitation, though the extent of degradation in the groves is less when compared with the other forests. Degradation of groves not only signifies loss of rich and relict vegetation but also the loss of rich cultural diversity. Therefore, it has become an urgent need to make an extensive inventory of the groves, their biodiversity and ethnobotanical importance, and analyze the role of associated cultural and religious beliefs, and their conservation.

Affection towards nature was a zoolatry (worshipping of animals), totem (considering plants and animals sacred), etc., which in turn led to a sort of prudent conservation. Religious beliefs, traditions and customs of Indians bear an allegiance in restricting the exhaustive use of natural resources. In the present study, an attempt has been made to document and analyze the vegetation composition and ethnobotanical uses of plant species in protected groves of Garhwal Himalaya. People's attributes towards the sacred groves were investigated to find out the causes of degradation and to develop strategies for their conservation.

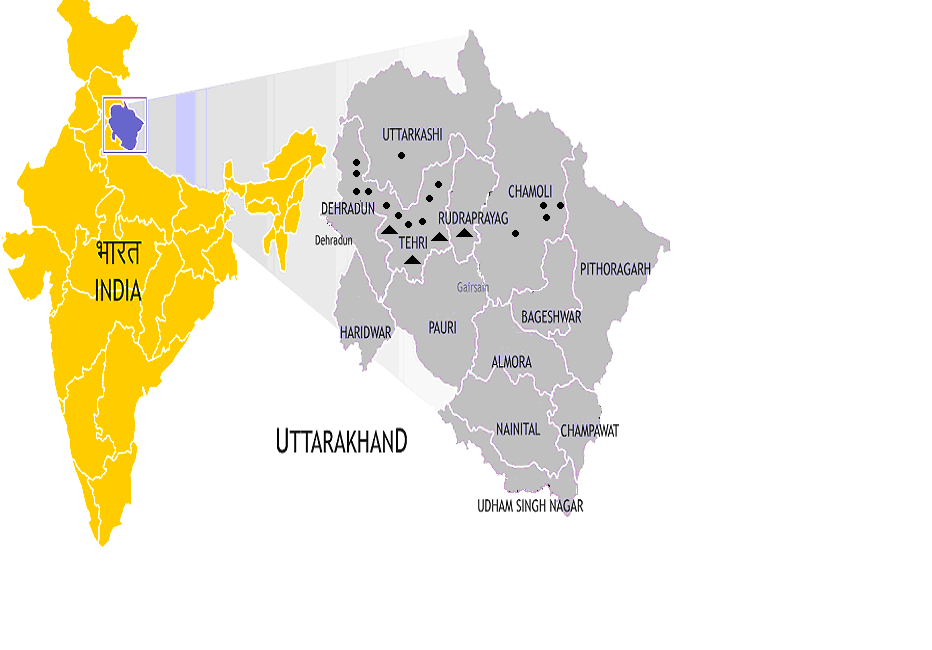


Figure 1. Map of Uttarakhand showing distribution of Protected Groves in Garhwal Himalaya. (⏶ ) Indicates the location of selected groves for the present study. From left to right are Kukuru Shah PG (PG 1), Dubakoti PG (PG 2), Hariyali Devi Sacred grove (PG 3) and Karuna Devi PG (PG4)

**2. Identification of Protected groves**

Fig. 3.2 a Climatic data of P G 1

An extensive field survey was undertaken to identify the protected groves of Garhwal Himalaya (Figure1). Records of local government and literature was screened to locate the grove and to ascertain their historical background. Traditional institutes such as village headman, priests and priestesses or the local folk, denizens and caretakers of the protected groves etc. were approached for identifying groves in the area under investigation. Data on protected groves were collected through various sources including informal and formal interviews and by visiting the groves and using a transect or quadrat.

Table 1. General characteristics of the selected protected groves

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name of grove** | **Locality** | **Area**  Sq.km. | **Aspect and position** | **Elevation range (meters)** |
| Kukuru shah van (PG1) | Lawa (Tehri) | 1.1 | Eastern Valley | 950-1200 |
| Dobakoti van  (PG2) | Gaja (Tehri) | 2.5 | Western hill slope | 1700-1900 |
| Hariyali Devi sacred Van (PG3) | Kodima (Rudraprayag) | 5.5. | Northwest hill top | 2800-3200 |
| Karuna sacred van (PG4) | Maruraghad (Tehri) | 1 | Eastern Valley | 850-1200 |

The identified groves were listed accordingly. Most of the protected groves were open and did not have well- demarcated boundaries, and therefore, the area measured for a given grove was mainly based on the information collected from the concerned village headman and through measurement based on an imaginary lines or boundary around the groves. The information about the protected groves has been obtained from multiple sources like interviewing large number of people around the groves, specially the people concerned with running and maintaining such places of worship. Inventories of thirty protected groves from the six districts of Garhwal Himalaya were collected and four protected groves from two districts were selected for the purpose of detailed studies on floristic composition and ethnobotanical importance. The selection of these four groves was made taking into consideration their size, vegetation and location. The selected protected groves were Kukuru Shah (PG 1) Dobakoti (PG2) Hariyali Devi (PG3) and Karuna van (PG4). Among these one is temperate and rests are sub-tropical forests as their dominant vegetation. General information about these four groves is summarized in Table1.

Table 2. Physicochemical features of the sorts of four groves

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **PG 1** | **PG 2** | **PG 3** | **PG 4** |
| Organic carbon (%) | 1.07 | 1.04 | 1.12 | 0.98 |
| Total Nitrogen (%) | 0.047 | 0.10 | 0.15 | 0.14 |
| Soluble Phosphorus (kg/ha) | 12.31 | 14.44 | 12.99 | 12.82 |
| Exchangeable Potassium | 212 | 197.66 | 200 | 176.66 |
| pH | 6.09 | 6.07 | 6.04 | 6.11 |
| Plant diversity (Total no. of species) | 110 | 129 | 84 | 114 |

**3. Methodology**

The Lesser Himalaya and Shivalik region of Gahwal Himalaya was surveyed for two successive years (December 2005- July 2007). Phytosociological studies in the groves were carried out by quadrat method. Ten quadrats of 10 x 10m were laid randomly in each grove for tree species. Ten quadrats of 5 x 5m for shrubs and 20 quadrats of 1 x 1m size for herbs were laid within the same 10 x 10m quadrats that were laid for the study of tree species. Density (tree ha-1) and basal area values were calculated for each species. Importance Value Index (IVI) of each species was calculated as per Misra (1968). The similarity index (Sorensen 1948), species diversity index (Shannon and Weiner 1963), concentration of dominance of the community (Simpson 1949), species richness index (Menthinick 1964) and evenness index (Pielou 1969) were calculated following the formula as given by them.

**4. Results and discussion**

An ethnobotanical survey was carried out to collect information on the uses of plants in medicinal and other purposes by local people who reside near the groves. Detail information on herbal drug plants was gathered from the local 'Vaidys' to whom the traditionation knowledge was passed on from their ancestors. Other ethnobotanical data were prepared, including the collection of information through folk, oral tradition, etc. The floristic composition of the four groves is summarized in Table 3. Angiospermic flora, of the study site comprises total 271 species respectively 87 families, 250 species were dicotyledons (75 families) and 21 species of monocotyledons (12 families) collected during the study period. Out of 87 angiospermic families, Lamiaceae contributed maximum share 8.9% (24 species), followed by Asteraceae 8.5% (23 species) Euphorbiaceae 7.0% (19 species) and Rosaceae 5.5% (15 species), Apiaceae and Ranunculaceae both 3.3% (9 species each), Acanthaceae 3.0% (8 species). Out of 87 families, single genera and species, 46 families with single genera but two to more species represented 6 families (Table 3).

Table 3. Floristic composition of four protected groves.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family** | **Genera** | **Percentage** | **Species** | **Percentage** |
|  | **No.** |  | **No.** |  |
|  |  |  |  |  |
| Acanthaceae | 6 | 2.8 | 8 | 3.0 |
| Amarantaceae | 2 | 0.9 | 3 | 1.1 |
| Anacardiaceae | 6 | 1.9 | 6 | 1.8 |
| Apiaceae | 7 | 3.3 | 9 | 3.3 |
| Apocynaceae | 1 | 0.5 | 1 | 0.4 |
| Aquifoliaceae | 1 | 0.5 | 1 | 0.4 |
| Araceae | 1 | 0.5 | 1 | 0.4 |
| Araliaceae | 1 | 0.5 | 1 | 0.4 |
| Asclepiadaceae | 1 | 0.5 | 1 | 0.4 |
| Asteraceae | 20 | 9.5 | 23 | 8.5 |
| Balsaminaceae | 1 | 0.5 | 2 | 0.7 |
| Berberidaceae | 1 | 0.5 | 1 | 0.4 |
| Betulaceae | 2 | 0.9 | 2 | 0.7 |
| Bombacaeae | 1 | 0.5 | 1 | 0.4 |
| Boraginaceae | 1 | 0.5 | 2 | 0.7 |
| Brassicaceae | 1 | 0.5 | 1 | 0.4 |
| Buddlejaceae | 1 | 0.5 | 1 | 0.4 |
| Burseraceae | 1 | 0.5 | 1 | 0.4 |
| Buxaceae | 1 | 0.5 | 1 | 0.4 |
| Caesalpinaceae | 2 | 0.9 | 6 | 2.2 |
| Cannabinaceae | 1 | 0.5 | 1 | 0.4 |
| Caprifoliaceae | 3 | 1.4 | 3 | 1.1 |
| Caryophyllaceae | 3 | 1.4 | 3 | 1.1 |
| Celastraceae | 1 | 0.5 | 1 | 0.4 |
| Chenopodiaceae | 1 | 0.5 | 1 | 0.4 |
| Combretaceae | 1 | 0.5 | 1 | 0.4 |
| Convolvulaceae | 1 | 0.5 | 4 | 1.5 |
| Cornaceae | 1 | 0.5 | 1 | 0.4 |
| Crassulaceae | 1 | 0.5 | 1 | 0.4 |
| Cucurbitaceae | 1 | 0.5 | 1 | 0.4 |
| Cupressaceae | 1 | 0.5 | 1 | 0.4 |
| Cuscutaceae | 1 | 0.5 | 1 | 0.4 |
| Cyperaceae | 1 | 0.5 | 1 | 0.4 |
| Dipsacaceae | 1 | 0.5 | 1 | 0.4 |
| Elaeagnaceae | 1 | 0.5 | 1 | 0.4 |
| Ericaceae | 2 | 0.9 | 3 | 1.1 |
| Euphorbiaceae | 12 | 5.7 | 19 | 7.0 |
| Fabaceae | 3 | 1.4 | 4 | 1.5 |
| Fagaceae | 1 | 0.5 | 3 | 1.1 |
| Gentianaceae | 3 | 1.4 | 5 | 1.8 |
| Geraniaceae | 1 | 0.5 | 1 | 0.4 |
| Hippocastanaceae | 1 | 0.5 | 1 | 0.4 |
| Hydrangeaceae | 1 | 0.5 | 1 | 0.4 |
| Hypericaceae | 1 | 0.5 | 2 | 0.7 |
| Juglandaceae | 1 | 0.5 | 1 | 0.4 |
| Lamiaceae | 18 | 8.5 | 24 | 8.9 |
| Lauraceae | 3 | 1.4 | 3 | 1.1 |
| Linaceae | 1 | 0.5 | 1 | 0.4 |
| Lythraceae | 1 | 0.5 | 1 | 0.4 |
| Malvaceae | 3 | 1.4 | 4 | 1.5 |
| Meliaceae | 2 | 0.9 | 2 | 0.7 |
| Menispermaceae | 1 | 0.5 | 1 | 0.4 |
| Mimosaceae | 2 | 0.9 | 3 | 1.1 |
| Moraceae | 2 | 0.9 | 6 | 2.2 |
| Myricaceae | 2 | 0.9 | 2 | 0.7 |
| Myrsinacaeae | 1 | 0.5 | 1 | 0.4 |
| Nyctaginaceae | 1 | 0.5 | 1 | 0.4 |
| Oleaceae | 1 | 0.5 | 1 | 0.4 |
| Onagraceae | 2 | 0.9 | 2 | 0.7 |
| Oxalidaceae | 1 | 0.5 | 2 | 0.7 |
| Papaveraceae | 1 | 0.5 | 1 | 0.4 |
| Pinaceae | 3 | 1.4 | 4 | 1.5 |
| Piperaceae | 1 | 0.5 | 1 | 0.4 |
| Poaceae | 7 | 3.3 | 7 | 2.6 |
| Polygonaceae | 2 | 0.9 | 4 | 1.5 |
| Ranunculaceae | 5 | 2.4 | 9 | 3.3 |
| Rhamnaceae | 1 | 0.5 | 2 | 0.7 |
| Rosaceae | 12 | 5.7 | 15 | 5.5 |
| Rubiaceae | 4 | 1.9 | 4 | 1.5 |
| Rutaceae | 5 | 2.4 | 6 | 2.2 |
| Salicaceae | 1 | 0.5 | 1 | 0.4 |
| Santalaceae | 1 | 0.5 | 1 | 0.4 |
| Sapotaceae | 1 | 0.5 | 1 | 0.4 |
| Saxifragaceae | 2 | 0.9 | 2 | 0.7 |
| Scrophulariaceae | 4 | 1.9 | 4 | 1.5 |
| Smilacaceae | 1 | 0.5 | 1 | 0.4 |
| Solanaceae | 3 | 1.4 | 4 | 1.5 |
| Sterculiaceae | 1 | 0.5 | 1 | 0.4 |
| Symplocaceae | 1 | 0.5 | 1 | 0.4 |
| Urticaceae | 5 | 2.4 | 5 | 1.8 |

Verbenaceae 2 0.9 2 0.7

Violaceae 1 0.5 3 1.1

Zingiberaceae 1 0.5 1 0.4

**4.1 Vegetation:**

Diverse habitats harbour a variety of plant species and the later are used by human in many ways. The floristic composition varied across the four sacred groves (Table 3). This may be due to the variation in edaphic factors, microclimate and biotic interferences among the groves. Though there is no sharp boundary, vegetation of the groves is restricted to the grove alone and has not expanded to the adjoining areas. It may be poor natural regeneration in the peripheral area (PG1 and PG2) or lack of appropriate conditions for the species to establish them. A total of 271 species representing 211 genera under 88 families were recorded from four protected groves during regular surveys for two consecutive years (Figure2). Of these, 59 species were trees representing 46 genera under 33 families. One species was lianas of Mimosaceae from grove 1. Sixty six species were shrubs belonging to 40 families and 53 genera. Out of the total vascular plants, angiosperms contributed the highest (92.5%), followed by pteridophytes (3.5%) and gymnosperms (0.58%). The maximum number of species was found in family Lamiaceae and Asteraceae (24 and 23 each) followed by Euphorbiaceae and Rosaceae having 19 and 15 species each.

**Vegetation analysis of protected groves**

1. **Protected Grove (PG 1):** In the KKS grove, 32 woody species were recorded belonging to 27 genera and 18 families. Based on the contributed IVI value of species *Buchanania lanzan* (katkafal), dominant tree species. Among tree species, *Buchanania lanzan* was dominant (7.6) followed by *Mallotus philippensis* species, (3.90), *Lannrea coromandelica* (3.10) and *Acacia catechu* (2.90). *Toona ciliata* with the density of 8 individuals (ha-1) scored the highest basal area (5.47 m2 ha-1) than *Juglans regia* (4.70 m2 ha-1) having 4 individuals. This may be due to the fact that the individuals of *Toona ciliata* are mature and have a larger girth. Twenty six species of shrubs belonging to 22 genera and 18 families were recorded in this grove. *Euphorbia royleana* (IVI: 33.78) and *Zanthoxylum armatum* (IVI: 21.97) were the dominant shrubs. The grove is rich in ground vegetation having 52 species of herbs representing 44 genera belonging to 25 families. The herbs were dominated by *Cynodon dactylon* (IVI: 6.43), *Poa annua* (IVI: 5.66), *Stellaria media* (IVI: 5.29) and *Centella asiatica* (IVI: 5.29), and many other useful medicinal herbs are confined to this grove. Various red fungi are found abundantly in this grove during summer.
2. **Protected Grove (PG 2):** Seventeen woody species falling in 14 genera in 11 families were recorded in the Dobakoti grove. Based on IVI values *Rhododendron arboreum* (29.63) was observed to be dominant species and *Quercus semecarpifolia* (24.33), *Prunus cerasoides* (22.91) and *Quercus leucotrichophora* (13.29) were co-dominant species. Among these *Rhododendron arboreum* contributed highest basal cover (249.68 m2 ha1), followed by *Q. semecarpifolia* (211.17 m2 ha-1). Thirty one species of shrubs with 29 genera and 20 families were found in the grove. The dominant shrubs includes *Rosa brunoni* (IVI: 14.64) followed by *Berberis asiatica* (IVI: 13.58) and *Rubus ellipticus* (IVI: 13.29). The ground vegetation was represented by 84 species of herbs belonging to 73 genera and 39 familiea. *Erigeron canadensis* was the dominant shrub (IVI: 3.73), followed by *Bupleurum falcatum* (IVI: 3.18) and *Bidens bipinnata* (IVI: 3.17). The Dobakoti grove is not only rich in flora but is also the home of arboreal mammals like monkeys, flying fox, birds, etc.
3. **Protected Grove (PG 3):** Twenty- three woody species belonging to 20 genera and 14 families were recorded in this grove, *Rhododendron arboreum* (IVI: 42.96) is the dominant tree species, followed by *Quercus semecarpifolia* (IVI: 31.68) and *Quercus leucotrichophora* (IVI: 25.73). Shrubs were represented by 27 species representing 25 genera and17 families. *Deutzia compacta* (IVI: 15.50), *Abelia triflora* (IVI: 14.70) and *Spiraea bella* (IVI: 13.92) were the dominant shrubs. Herbs were represented by 45 species in 42 genera and 30 families. Based on IVI values, *Bulpleurum marginatum* (IVI: 4.79), *Urtica diocia* (IVI: 4.50) *Viola biflora* (IVI: 4.52) and *Justicia procumbens* (IVI: 4.48), were the dominant herbs.
4. **Karuna Devi Protected Grove (PG 4):** Thirty one woody species belonging 23 genera and 20 families were observed in this grove. *Mallotus philippensis* (IVI: 13.76), *Ficus auriculata* (IVI: 13.75) and *Toona ciliata* (IVI: 13.42) are the dominant tree species. Only 26 species of shrubs were found in this grove belonging to 24 genera and 18 families. *Euphorbia royleana* (IVI: 34.63), *Zanthoxylum armatum* (IVI: 20.25) and *Woodfordia fruticosa* (IVI: 14.72) were doimant shrubs. Sixty eight species of herbs represent ground vegetation and belonged to 53 genera and 27 familes. Dominant herb species were *Cynodon dactylon* (IVI: 6.44), *Poa annua* (IVI: 5.67), *Stellaria media* (IVI: 5.60).

Table 4. Similarity (based on Sorensen similarity index (%) among the tree, shrub and herb species occurring in the selected Protected groves (T – trees, S – shrubs and H – herbs).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Groves | (PG2) |  |  | (PG2) |  |  | (PG4) |  |  | |  | T | S | H | T | S | H | T | S | H | | (PG1) |  |  |  |  |  |  |  |  |  | | T | 11.76 |  |  | 7.27 |  |  | 76.05 |  |  | | S |  | 7.01 |  |  | 7.69 |  |  | 78.68 |  | | H |  |  | 11.42 |  |  | 14.95 |  |  | 85.33 | | (PG2) |  |  |  |  |  |  |  |  |  | | T |  |  |  | 28.57 |  |  | 10.34 |  |  | | S |  |  |  |  | 23.72 |  |  | 14.7 |  | | H |  |  |  |  |  | 20.97 |  |  | 11.53 | | (PG3) |  |  |  |  |  |  |  |  |  | | T | 33.35 |  |  |  |  |  | 6.19 |  |  | | S |  | 23.72 |  |  |  |  |  | 7.17 |  | | H |  |  | 23.77 |  |  |  |  |  | 12.85 | |

**4.2. Comparison of diversity of the four protected groves**

The similarity index among the four protected groves varied considerably (Table 4). The highest similarity index was observed between groves 1 and 3 exhibiting 80.02% and lowest between groves 1 and 2 (1.06%). While considering the similarity index value among the tree, shrub and herb species separately, the maximum similarity value (%) was evinced between groves 1 and 4 contributing 76.05% for tree, 78.68% for shrub and 85.33% for herb species (Table 4). Groves 3 and 4 were least similar in terms of tree species having 7.17% similarity index, while groves 1 and 2 showed least similarity (11.42%) for herb species.

The maximum similarity index value for shrubs was displayed between groves 1 and 4 exhibiting 78.68% and groves 2 and 3 recording 28.57%. The density and IVI values of each species are given in Table 5 Some groves with least common species among the four groves may be due to diverse natural ecosystems, altitudinal variation, edaphic, physiographic and micro environment factors. The transition of vegetation type and habitat complexity in each grove may restrict the occurrence of similar species in different groves. The vegetation of the two groves located in the similar areas (1 and 4) was found to be similar. The reason may be attributed to close altitudinal range, physiographic, soil and climatic conditions, etc.

Table 5 Density (plant ha-1) and Importance value index (IVI) of different plant species occurring in the selected protected groves of Garhwal Himalaya.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **species** | **PG1** |  | **PG2** |  | **PG3** |  | **PG4** |  |
|  | **Density**  **/ha** | **IVI** | **Density**  **/ha** | **IVI** | **Density**  **/ha** | **IVI** | **Density**  **/ha** | **IVI** |
| **tree** |  |  |  |  |  |  |  |  |
| *Acacia catechu* | 2.9 | 11.6 |  |  |  |  | 4.4 | 12.77 |
| *Benthamedia capitata* |  |  | 6.3 | 14.43 | 5.8 | 9.01 |  |  |
| *Betula alnoides* |  |  |  |  | 106.6 | 15.70 |  |  |
| *Bomax ceiba* | 1.3 | 10.91 |  |  |  |  | 1.7 | 11.27 |
| *Emblica officinalis* |  |  | 4.2 | 13.56 |  |  |  |  |
| *Ficus auriculata* | 2.3 | 12.19 |  |  |  |  | 4.3 | 13.75 |
| *Ficus palmate* | 2.6 | 10.23 | 6.9 | 16.53 |  |  | 3.2 | 10.2 |
| *Garuga pinnata* |  |  | 6.3 | 19.94 |  |  |  |  |
| *Buchanania lanzan* | 7.6 | 22.46 |  |  |  |  |  |  |
| *Lannea coromandelica* | 3.1 | 12.67 |  |  |  |  | 4.1 | 13.09 |
| *Lyonia ovalifolia* |  |  |  |  | 133.5 | 19.16 |  |  |
| *Madhuca longifolia* |  |  | 5.5 | 15.51 |  |  |  |  |
| *Mallotus philippensis* | 3.9 | 13.06 |  |  |  |  | 5.4 | 13.76 |
| *Myrica esculenta* |  |  | 10.3 | 22.18 | 22.60 | 14.61 |  |  |
| *Picea smithiana* |  |  |  |  | 2 | 13.94 |  |  |
| *Pinus roxburghii* | 1.4 | 12.3 |  |  |  |  | 2.6 | 13.18 |
| *Pinus wallichiana* |  |  |  |  | 8.3 | 20.86 |  |  |
| *Pyrus pashia* | 2.3 | 11.14 | 6.1 | 16.23 | 7.5 | 7.44 | 3.5 | 12.19 |
| *Quercus floribunda* |  |  | 9.4 | 22.91 | 19.5 | 21.55 |  |  |
| *Quercus leucotrichophora* |  |  | 7.9 | 22.39 | 183.2 | 25.73 |  |  |
| *Quercus semecarpifolia* |  |  | 8.5 | 24.33 | 256 | 31.68 |  |  |
| *Rhododendron arboreum* |  |  | 10.6 | 29.63 | 403.4 | 42.96 |  |  |
| *Rhododendron barbatum* |  |  |  |  | 16.3 | 16.65 |  |  |
| *Syzygium cumini* | 0.8 | 11.04 |  |  |  |  | 1.2 | 11.64 |
| *Tectona grandis* | 0.9 | 10.18 |  |  |  |  | 1.7 | 11.3 |
| *Toona ciliate* | 0.8 | 12.21 |  |  |  |  | 1.6 | 13.42 |
| **shrub** |  |  |  |  |  |  |  |  |
| Artemisia roxburghiana |  |  | 4.8 | 11.68 |  |  |  |  |
| *Berberis asiatica* |  |  |  |  | 9 | 12.33 |  |  |
| *Boenninghausenia albiflora* |  |  | 3.6 | 9.6 | 6.1 | 11.62 |  |  |
| *Bambusa arundinacea* | 1.4 | 14.57 |  |  |  |  | 2.4 | 15.1 |
| *Buddleja asiatica* |  |  | 3.8 | 10.28 |  |  |  |  |
| *Cassia tora* | 3.1 | 11.36 |  |  |  |  | 5.1 | 12.3 |
| *Cotoneaster microphyllus* |  |  | 3.9 | 11.13 |  |  |  |  |
| *Daphne papyracea* |  |  | 2.2 | 6.9 | 7.8 | 11.37 |  |  |
| *Debregeasia longifolia* |  |  |  |  | 8.7 | 13.34 |  |  |
| *Desmodium elegans* |  |  |  |  | 7.3 | 13.6 |  |  |
| *Deutzia compacta* |  |  |  |  | 11.7 | 15.5 |  |  |
| *Euphorbia royleana* | 2.8 | 33.78 |  |  |  |  | 4.6 | 34.63 |
| *Indigofera heterantha* |  |  | 2.7 | 11.3 | 4 | 8.41 |  |  |
| *Inula cappa* |  |  | 2.7 | 13 |  |  |  |  |
| *Murraya paniculata* | 4.8 | 13.16 |  |  |  |  | 5.8 | 12.57 |
| *Prinsepia utilis* |  |  | 4.5 | 12.41 | 5.4 | 9.59 |  |  |
| *Reinwardtia indica* | 5.1 | 11.84 |  |  |  |  | 6.9 | 11.94 |
| *Rhus ellipticus* | 1.4 | 12.82 |  |  |  |  | 3.4 | 14.32 |
| *Rhus parviflora* | 3.7 | 11.73 | 4.7 | 11.97 |  |  | 3.7 | 10.53 |
| *Rosa brunoni* | 3.4 | 8.28 | 6.3 | 14.64 | 6 | 10.91 | 3.8 | 7.56 |
| *Roylea cinerea* | 6.1 | 13.82 |  |  |  |  | 6.4 | 12.12 |
| *Rubus ellipticus* |  |  | 5.5 | 13.29 |  |  |  |  |
| *Sarcocca saligna* |  |  |  |  | 7.1 | 12.8 |  |  |
| *Spiraea bella* |  |  | 4 | 10.16 | 4.9 | 13.92 |  |  |
| *Viburnum cotinifolium* |  |  |  |  | 7.4 | 11.47 |  |  |
| *Woodfordia fruiticosa* | 3.9 | 14.52 | 5 | 11.31 |  |  | 5.4 | 14.72 |
| *Zanthoxylum armatum* | 3.5 | 21.97 |  |  | 4.7 | 9.48 | 2.9 | 20.25 |
| **Herb** |  |  |  |  |  |  |  |  |
| *Ageratum conyzoides* | 16.7 | 4.61 | 21.9 | 3.01 | 10.6 | 3.48 | 16.7 | 62 |
| *Agrimonia pilosa* |  |  |  |  | 16.3 | 4.91 |  |  |
| *Apluda mutica* | 27.3 | 5.02 |  |  |  |  | 27.3 | 5.02 |
| *Argemone mexicana* | 24.3 | 5.11 |  |  |  |  | 24.3 | 5.12 |
| *Arisaema intermedium* |  |  |  |  | 13 | 4.36 |  |  |
| *Arisaema jacquemontii* |  |  |  |  | 13.4 | 4.43 |  |  |
| *Bryophyllum pinnatum* |  |  | 10.7 | 1.64 | 17 | 4.79 |  |  |
| *Bupleurum falcatum* |  |  | 24.5 | 3.18 |  |  |  |  |
| *Centella asiatica* | 21.9 | 5.29 |  |  |  |  | 21.9 | 5.3 |
| *Crotalaria medicaginea* |  |  | 19.8 | 2.87 |  |  |  |  |
| *Cynodon dactylon* | 34.4 | 6.43 |  |  |  |  | 34.4 | 6.44 |
| *Desmodium heterocarpon* |  |  | 22.5 | 2.89 |  |  |  |  |
| *Erigeron canadensis* |  |  | 7.6 | 3.73 |  |  |  |  |
| *Gerbera gossypina* |  |  | 22.8 | 3.07 |  |  |  |  |
| *Justicia procumbens* |  |  |  |  | 13.7 | 4.48 |  |  |
| *Lespedeza juncea* |  |  |  |  | 14.4 | 4.35 |  |  |
| *Leucas cephalotes* | 19.6 | 4.74 |  |  |  |  | 19.6 | 4.75 |
| *Origanum vulgare* |  |  | 16 | 1.99 | 14.6 | 4.39 |  |  |
| *Pimpinella diversifolia* |  |  | 20.6 | 2.92 | 13 | 3.39 |  |  |
| *Plectranthus mollis* |  |  | 22.2 | 3.03 |  |  |  |  |
| *Poa annua* | 36 | 5.66 |  |  |  |  | 36 | 5.56 |
| *Potentilla fulgens* |  |  | 23 | 3.08 | 9.9 | 3.85 |  |  |
| *Ranunculus laetus* |  |  |  |  | 15.6 | 4.31 |  |  |
| *Stellarea media* | 28 | 5.59 |  |  | 12.8 | 3.6 | 28 | 5.6 |
| *Tagetes minuta* |  |  | 23.5 | 2.96 |  |  |  |  |
| *Tridax procumbens* | 19 | 4.91 |  |  |  |  | 19 | 4.92 |
| *Urtica dioica* |  |  |  |  | 15.3 | 4.5 |  |  |
| *Viola betonicifoila* | 20.3 | 5.08 | 16.1 | 2 | 4.5 | 2.22 | 20.3 | 5.09 |
| *Viola biflora* |  |  |  |  | 18.2 | 4.5 |  |  |

Species richness is one of the major criteria in recognizing the importance of an area for conservation. In general, species richness in grove 2 is greater than the other three groves. Species richness, species richness index, species diversity, concentration of dominance and evenness index recorded for the four protected groves are given in Table 7. The highest species richness for tree species was recorded for PG I (32 species) and lowest for PG II (19 species). In case of species richness index of tree species it was again set highest in PG I (1.39) and lowest in PG II (0.51).

Table 6. Species richness (SR), species richness index (SRI), diversity index (H'), concentration of dominance (Cd) and Evenness index (E) computed in selected groves.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **groves** | **SR** |  |  | **SRI** |  |  | **H'** |  |  | **Cd** |  |  | **E** |  |  |
|  | **T** | **S** | **H** | **T** | **S** | **H** | **T** | **S** | **H** | **T** | **S** | **H** | **T** | **S** | **H** |
| **PG 1** | 32 | 25 | 52 | 1.39 | 0.94 | 0.59 | 3.21 | 3.18 | 3.84 | 0.05 | 0.04 | 0.02 | 0.93 | 0.98 | 0.97 |
| **PG 2** | 19 | 31 | 84 | 0.51 | 0.93 | 0.75 | 2.78 | 3.35 | 4.5 | 0.07 | 0.04 | 0.01 | 0.98 | 0.98 | 1 |
| **PG3** | 23 | 27 | 55 | 0.52 | 0.65 | 0.72 | 2.94 | 3.26 | 3.98 | 0.06 | 0.04 | 0.02 | 0.94 | 0.99 | 0.99 |
| **PG 4** | 29 | 36 | 68 | 1.15 | 0.81 | 0.6 | 3.27 | 3.21 | 3.84 | 0.04 | 0.04 | 0.02 | 0.94 | 0.98 | 0.97 |

The number of shrub species in the grove was smaller than the tree and herb species. Groves 1 and 2 showed 25 and 31 species each, grove 3 recorded 27 species and grove 4 attained the highest number having 36 species. The maximum species of herbs were recorded in PG 1 and 4 with 84 and 68 species each and the minimum in PG 1 with 52 species only.

Table 7. Species similarity (based on Sorensen similarity index (%) among the select protected groves.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sacred**  **Grove** | **PG 2** | **PG 3** | **PG 4** |
| **PG 1** | 1.06 | 9.97 | 80.02 |
| **PG 2** | 100 | 24.42 | 12.19 |
| **PG 3** | 26.94 | 100 | 8.73 |

The species richness index of shrubs ranged from 0.65 (PG 3) to 0.94 (PG 1), whereas for herbs it varied from 0.59 (PG 1) to 0.75 (PG 2).The value of Shannon and Wiener species diversity index for tree species fluctuated from 2.78 (PG 2) to 3.27 (PG 4). For shrubs, it ranged from 3.21 (PG 4) to 3.35 (PG 2), while for herb species the value was maximum in PG 2 (3.35) and minimum in PG 4 (3.21). It is apparent from Table 7 that PG1 and 4 exhibited highest similarity followed by PG 2 and PG 4. The reason for highest similarity coefficient lies in common aspect (eastern valley) and elevation range.

**5. Ethnobotanical uses of species and conservation status**

Ethnobotanical use of plants has been known since time immemorial in the history of human civilization and without these medicinal plants good health in the past would have been impossible. Ethnobotany explains the holistic scope of the relationship between plant and human being. Still, many communities of Garhwal depend largely on medicinal plants. The utilization of plants and animals for medicinal purposes is closely related with their culture and ritual practices which have been developed by their forefathers through trial and error methods and passed on orally from generation to generation. Traditional knowledge systems of folk, oral tradition and the published and unpublished manuscripts are the important sources of locating the potential of bioresources. Unfortunately, the lack of written data, communication and intermingling due to the varying ways of life, many of the earlier remedies that survived only by word of mouth from generation to generation are slowly disappearing.

Moreover, herbal healers had a strong tendency to keep their knowledge secret without any documentation until the end of their life. Out of 271 species altogether recorded from the four protected groves, 220 species are found to be of medicinal value. Indeed, it is evident that sacred groves are the storehouse of many useful medicinal plants. Therefore, protection and conservation of protected groves is essential for the conservation of medicinal plants. Four species, *Arisaema jacquemontii*, *Barleria cristata,* *Delphinium denudatum* and *Rubia manjith* among the 220 medicinal plants, are used especially for the treatment of snake bite. Besides their medicinal values, some of the species are employed in different uses like traditional soap and detergent, hair lotion and sericulture. The products of *Dioscorea deltoides* and *Sapindus mukorossi* are used in preparation of traditional soap and detergents for washing clothes by the people of Garhwal Himalaya. *Ageratum conyzoides*, *Artemisia nilagirica*, *Oxalis corniculata*, and *Phyllanthus emblica* are the species used as an ingredient for the preparation of indigenous hair lotion. *Litsea umbrosa* and *Quercus serrata* are the sericulture trees. A few of the sacred species found in the groves are associated in rituals or are believed to be the icon of the deity. Different faith and beliefs related to the sacred species include curing sickness, purifying household, purifying of the person before entering the shrine etc. various medicinal plants are also used as vegetables, spices etc. Interesting information comes through interviews with the local people who reside near the groves. Many people revealed that they had never consulted any doctor till date nor taken any tablets or pills. Headache, fever, cold, body pain can easily be cured with the help of medicinal plants. Some people used to consume daily a little amount of bitter, sour or sweet exudates from the plant parts which protects them from physical problems.

Table 8. Ethnobotanical Importance of Plants

|  |  |  |  |
| --- | --- | --- | --- |
| **Botanical name** | **Vernacular name** | **Disease/aliment** | **Part used/mode of application** |
| *Aconitum atrox* | Meetha Bish | Rheumatism, Paralysis  Dyspepsia, Phthisis & fever | Paste of rhizomes fried in Ghee for external used. |
| *Actaea acuminate* | Mamira | Bronchial | Decoction of root |
| *Allium consanguineum* | Pharan | Indigestion | Leaves |
| *Anemone polyanthes* | Ratanjot | Food poisoning | Seed decoction |
| *Angelica glauca* | Choru | Flatulence, colic | Root-stocks |
| *Arisaema wallichianum* | Meen erysipelas | Erysipelas and Scabies | Root-past (externally) |
| *Arnebia benthamii* | Laljari balchari | Cuts and wounds | Juice of fresh root |
| *Asparagus filicinus* | Jhirni | Urinogenital disorders | Power of dried tuberous root |
| *Bergenia stracheyi* | Shilphari | Kidney stones, sores, jaundice | Decoction of roots |
| *Caltha palustris* | Kushnya | Abscesses | Leave juice |
| *Dactylorrhiza hatagirea* | Salampanja | Cuts and wounds | Power of the root |
| *Delphinium denudatum* | Nirbishi | Contusions | Root paste |
| *Dioscorea bulbifera* | Genthi | Bronchial coughs | Tubers |
| *Dioscorea deltoides* | Tairu | spermatonorrhoea | Rhizomes |
| *Euphorbia hirta* | Dudhibari | Piles | Entire plant with curd |
| *Fumaria indica* | Pitapapra | Fever | Juice of entire plant |
| *Gentiana stipitata* | Bumlya | Urinary infection | Root decoction |
| *Geranium wallichiana* | Neenai | Dysentery and diarrhoea | Root decoction |
| *Hippophae rhamnoides* | Dhooplakkar | Cardiac trouble | Fruit juice |
| *Megacarpea polyandra* | Barmoola | Fever, stomachache | Root |
| *Morina longifolia* | Bishkandara | Snake-bite | Root-decoction |
| *Origanum vulgare* | Bantulsi | Whooping cough | Extract of leave |
| *Paris polyphylla* | Satwa | Diarrheoa | Root power |
| *Picrorrhiza scrophulariflora* | Kutki | Server coughing, fever | Root power |
| *Rheum australe* | Dolu | Bone-ache, muscular pains. | Root paste mixed with turmeric. |
| *Solanum nigrum* | Makoi | Spleen | Infusion of leaves and stem |
| *Swertia chirayita* | Chirayata | Fever | Decoction of entire plant |
| *Taraxacum officinale* | Dudhli | Gall stones | Power of root |
| *Thalictrum foliolosum* | Pilijari | Eye-inflammation | Root-decoction |
| *Thymus linearis* | Van Ajwain | Asthmatic cough | Extract of leaves and floral heads |
| *Typhonium diversifolium* | Nakdoon | Anorexia and as an energetic | Root power mixed with honey |
| *Urgenia indica* | Vanpyaz | Intestinal colic | Juice of tubers |
| *Urtica ardens* | Kandali | Dysmenorrheal | Decoction of entire plant |
| *Vitex negundo* | Shinwali | Arthritis, Gout | Leave-decoction |
| *Woodfordia fruticosa* | Dhaula | Vaginitis | Powder of dried flowers |
| *Zanthoxylum armatum* | Timru | Tooth-ache, Tooth decay | Seed power, Stem bark |

Many people of Garhwal Himalaya still depend on herbal medicine, though they are highly adjustable with the influences of modern practices and widespread use of allopathic medicine. Therefore, it is necessary to know the potential and values of medicinal plants for the improvement of health and hygiene in an eco-friendly manner. The data generated from the present study regarding the medicinal plants may be helpful for the conservation strategies of protected groves by the government authority and other concerned organizations. Proper documentation of such plants and necessary action plans for their conservation are needed to taken up in time. It also required maintaining a sustainable use of such plants for their natural regeneration.

**6.5 Conservation status of protected groves:**

Earlier sacred groves were indicator of the phenomenon of ethno-environmental management. Our ancestors were fully aware that the natural resources that sustained them must be conserved for the sustenance of future generations. But, at present, fast growth of infra-structural facilities and on-farm activities is the prime cause of deteriorating quality status of the groves. As in the forest, many of the tree species are valuable timber species, they have been largely extracted for timber during the past few decades and thus, subsequently replacing the climax forests (oak) to early successional pine forests. This has done considerable ecological damage in the region, making the soil more acidic and adversely affecting nutrient cycling and soil fertility. Growth of tourism industry is also deteriorating the faith towards deity and groves. Protected groves are the victims of this grim tragedy. The groves located near the settlements are disappearing at a faster rate. Only few protected groves are in their pristine condition. These are Hariyali, Dubakoti, Kukuru Shah and Tardkeshwar in Garhwal Himalaya. Other groves are disappearing, as the forests are being cleared and utilized for construction and repairing of deity houses. Most of the temple groves are seen disappearing due to inevitable factors like animal grazing and human interference.

Protected groves are a social institution, which permits management of biotic resources through people’s participation. A scientific understanding of the protected groves would be significantly important for designing strategies for rehabilitation of degraded landscapes, involving local people’s participation, and training for promotion of traditional and social norms. There is a need of preservation, restoration and proper management of existing groves.

Various traditional approaches to conservation of nature require a belief system, which includes a number of prescriptions and proscriptions for restrained resource use. These forestlands need proper conservation and protection by formulating consistent conservation strategies in order to save them from the verge of further degradation. Proper legislative support and specific policies should be provided. Mushrooming infrastructure facilities in the area are deteriorating the proper functioning of social institutions, which reflect that protected or sacred groves are no longer getting the privilege they had in the past. Human interference should be regulated by encoding various indigenous practices along with scientific implications rather than only old religious prescriptions and proscriptions.

Table 9. Beliefs associated with plants

|  |  |  |  |
| --- | --- | --- | --- |
| **Botanical name** | **Vernacular names** | **Families** | **Belief /use** |
| *Acacia catechu* | Khair | Mimosaceae | Sacred tree |
| *Aegle marmelos* | Bel | Rutaceae | Sacred tree |
| *Artemisia nilagarica* | Kunja | Asteraceae | Use in rituals |
| *Azadirachtia indica* | Neem | Meliaceae | Sacred tree |
| *Betula utilis* | Bhoj | Betulaceae | Use in rituals |
| *Bombax ceiba* | Semal flower | Bombaceae | Use in rituals |
| *Cedrus deodara* | Deodar | Pinaceae | Sacred tree |
| *Colebrookia oppositifolia* | Binda | Lamiaceae | Use in rituals |
| *Cynodon dactylon* | Dubla | Poaceae | Use in rituals |
| *Daphne papyracea* | Satpura | Thymelaeaceae | Use in rituals |
| *Ficus benghalensis* | Bar | Moraceae | Use in rituals |
| *Ficus religiosa* | Pipal | Moraceae | Sacred tree |
| *Mallotus philippensis* | Ruina | Euphorbiaceae | Use in rituals |
| *Mangifera indica* | Aam | Anacardiaceae | Sacred tree |
| *Musa paradisiaca* | Kela | Musaceae | Use in rituals |
| *Nardostachys grandiflora* | Jatamanshi | Valerianaceae | Use in rituals |
| *Phyllanthus emblica* | Amla | Euphorbiaceae | Sacred tree |
| *Pinus roxburghii* | Kulain, chir | Pinaceae | Use in rituals |
| *Prunus cerasoides* | Paiyan | Rosaceae | Use in rituals |
| *Quercus leucotrichophora* | Oak | Fagaceae | Sacred tree |
| *Reinwardtia indica* | Phulei | Linaceae | Use in rituals |
| *Rhododendron arboreum* | Burans | Ericaeae | Use in rituals |
| *Rhus parviflora* | Tungla | Anacardiaceae | Use in rituals |
| *Sassurea obvallata* | Brahm- kamal | Asteraceae | Use in rituals |
| *Sesamum orientale* | Til | Pedalaceae | Use in rituals |
| *Taxus baccata* | Thuner | Taxaceae | Sacred tree |
| *Urtica dioica* | kandali | Urticaceae | Use in rituals |
| *Vitex negundo* | Shiwali | Verbenaceae | Use in rituals |
| *Zanthoxylum armatum* | Timuroo | Rutaceae | Sacred tree |

**Correspondence to:**

Tapendra Singh Bisht

Department of Botany and Microbiology

H. N. Bahuguna Central University,

Srinagar Garhwal, Uttaranchal 246174, India.

E-mail: tapi\_bisht06@ yahoo.co.in

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