Dhwaj sacred grove: A unique example of cultural beliefs and traditional conservation

Harsh Singh¹* and Vaibhav Kumar²

¹Department of Botany, North-Eastern Hill University, Shillong, Meghalaya, India
²In Vitro Culture and Plant Genetics Unit, Department of Botany, Faculty of Science, University of Lucknow, Lucknow, 226007, Uttar Pradesh, India

*Corresponding Author: harshchamlegi@gmail.com

[Accepted: 17 September 2020]

Abstract: Sacred groves are well-protected areas managed by strong spiritual beliefs by the local communities and often represent the relict climax vegetation the region. The present study was conducted in Dhwaj sacred grove from the Central region of Indian Himalayas, releasing its role in biodiversity conservation through traditional and cultural belief systems. Total 81 species belonging to 67 genera and 50 families of plants were identified; in which 40 species were flowering plants, 23 species were lichens, 7 species bryophytes, 12 species were pteridophytes and only one species was gymnosperm. *Rhododendron arboreum* and *Quercus leuchotrichophora* is the most dominant tree species in the grove showing highest IVI values. Ethnobotanically, 40 species belonging to 38 genera and 27 families are used by the local communities for the treatment of various ailments. But, due to high anthropogenic pressure, this grove facing several threat of degradation, hence special attention is needed towards its conservation and motivation to promote our traditional knowledge.

Keywords: Indian Himalayan Region - Sacred groves - Phytodiversity - Ethno-medicinal plants - Threat - Conservation.

INTRODUCTION

A unique assemblage of flora and fauna in the Himalayan region makes it one of the important biodiversity hotspot on the Indian subcontinent. The people of this area have great affection to the nature and their indigenous knowledge of conserving ecosystem with great knowledge of sustainable utility are one of the factors which proof their close relationship with nature. This traditional knowledge enhances the respect towards spirituality and hence help in conservation (Vecsey 1980, Martinez 1996, Berkes 1999, Negi 2010, Ngbolua et al. 2016, Daba & Asfaw 2020).

Central Himalaya of India closely associated with many cultures, traditions, ethnic knowledge, folklores, etc. which is directly or indirectly affects the ecosystem. There were many traditional conservation practices of indigenous communities in many parts of the world, which contributed to the conservation of biodiversity. An excellent example of such traditional practices is the conservation of small or large patches by dedicating them to the local deities by various indigenous communities of the world. Such forest patches are called “sacred groves”. Sacred groves are the tracts of virgin forest that were left untouched by the local inhabitants, harbour rich biodiversity, and are protected by the local people due to their religious and cultural beliefs and taboos that the deities reside in them (Khan et al. 2008, Sukumaran et al. 2018). Sacred groves are the treasure house of natural vegetation and help in protection of society directly or indirectly (Schaff 1998, Deepa et al. 2016). These groves often represent the relict climax vegetation with many rare and endangered species (Gadgil & Vartak 1975, Tiwari et al. 1999, Deepa et al. 2017). These groves are located in various altitudinal regions and hence, play a significant role in the conservation of rare and endangered species of the faunal and floral part (Mgumia & Oba 2003). All forms of vegetation in such a groove, including shrubs and climbers are supposed to be under the protection of the reigning deity of that groove, and the removal of even a small twig, is taboo.
(Vartak & Gadgil 1973, Vartak 1983). These are the ancient natural forests where all forms of living creatures were afforded protection through the grace of some deity. These deities are generally of extremely primitive and fearsome nature and cutting or breaking even deadwood in a grove may result in a serious illness which has led in the protection of sacred forests in their virgin form. These groves have preserved the biological diversity of all level of that particular region which has vanished from other surrounding areas (Gadgil & Chandran 1992). Various studies are done throughout the world related to diversity and conservation of these groves and are named differently in various parts of India as Kovil Kadu in Karnataka, Oran in Rajasthan, Law lyngdhhoh in Meghalaya, Deovan in Himachal Pradesh, Saran and Deorai in Madhya Pradesh, Jaiherthan and Garanthan in West Bengal, Ummanglai in Manipur, Devtha than in Uttarakhand, etc. and are found in various habitats ranging from scrub forests of Thar desert maintained by Bishnois to Kerela in Western Ghats.

Many sacred groves are present in Garhwal and Kumaon Himalayan region with different cultures and traditions. Hariyali and Tarkesh war sacred groves from Garhwal Himalaya are one of the important examples of biodiversity conservation by religious beliefs system of the Himalayan region (Sinha & Maikhuri 1998, Ghilidiyal et al. 2008). Various deities living in the groves namely Golu, Gangnath, Haat Kali, Bhumi Dev, Shyamju, Harju, Kotgari etc. and are responsible for the existence of these primitive and conserve patches or forests in the area. The study is lacking in Kumaon region of Indian Himalaya only Thalkedar, Nakuleshwar, Haat Kali, Chamunda Devi, Malay Nath, Patel Bhuvneshwar, Vaishneo Devi sacred groves were reported (Negi 2005, Agnihotri et al. 2009, Singh et al. 2010, Singh et al. 2012, Agnihotri et al. 2010, Singh et al. 2014). Mostly the study was concise in documentation and inventory, thus, realizing the importance of sacred groves in biodiversity conservation (Mehra et al. 2014). Thus a study was conducted in newly reported Dhwaj sacred grove which is present in Central Himalaya region of India and represents a rich biodiversity with many endemic and threatened species.

MATERIALS AND METHODS

Study area

Dhwaj sacred grove is situated near Totanula, near about 15 kms from the main Pithoragarh town on the route of Didihat (Figs.1, 2). It is a beautiful place with the luxuriant growth of both lower and higher plants; hence showing great phytodiversity. About 2 to 3 km from the road by foot at an altitude of 2366 m asl (29º 38' 48.62“ N, 80º 17' 14.45“) below the main temple, is situated the cave temple of Lord Shiva (Baba Khandenath) and tribute the whole grove to local deities Jyanti Devi. On enquiry with the local peoples we came to know that this sacred grove is about 600-700 years old and covering an area of 3.0 ha approximately. The monthly average of minimum and maximum temperature fluctuated throughout the year from 0ºC to 18ºC and 13ºC to 25ºC respectively. In January (and February season of winter), snow remains in this area for one or two days or sometimes for few hours. The broad leaves trees of Quercus leucotrichophora A. Camus and Rhododendron arboreum Sm. are dominant in this grove and support the luxuriant growth of vascular and non-vascular plants. From the hilltop where the deity Jayanti Devi, (a much feared Goddess in the area) temple is situated; from there the peaks of Panchachuli and Nanda Devi of Himalayas.

![Figure 1. Location of study area in Pithoragarh district of Uttarakhand, India.](www.tropicalplantresearch.com)
Identification of the plant

Extensive field surveys were undertaken during 2008–2011 covering all the four seasons, viz. spring, rainy, summer and winter in the sacred grove. The existence of this grove was known from the local communities that reside in these areas. The different plant specimens were collected in the flowering and fruiting stage, or fertile stage in triplicate. Further, the specimens were processed as per standard herbarium techniques recommended (Jain & Rao 1977) and were deposited in LWG herbarium (herbarium at CSIR-National Botanical Research Institute), Lucknow. The specimens were identified based on morphological as well as micro-morphological characters and making use of different floras, monographs, revisions and other available literature (Osmaston 1927, Gupta 1968, Raizada & Saxena 1978, Naithani 1984, Gaur 1999, Awasthi 1991, 2007).

Species richness

For forest phytosociological study random stratified sampling 1 quadrates was used to assess ecological data in three forest layers (Greig-Smith 1983, Krebs 1989). Quadrates of 20 m × 20 m for tree species, 5 m × 5 m for shrub species and 1 m × 1 m for herb species were plotted to measure the frequency, density, abundance and species dominance since 1950 (Curtis & McIntosh 1950) Frequency, density, abundance & species dominance have been used to calculate the species Importance Value Index (IVI). Abundance and Frequency ratio (AF) for different species was determined for eliciting the distribution pattern in terms of regular (AF <0.025), random (AF = 0.025–0.05) and contagious (AF >0.05), as follows (Cottam & Curtis 1956).

RESULTS

Diversity in the grove

This grove is a good example of biodiversity conservation and representing 81 species belonging to 67 genera and 50 families of both flowering and non-flowering plants (Table 1). Angiosperm were represented by 40 species belonging to 35 genera and 27 families in which herbaceous life form was dominant comprises both angiosperm (28 species) and pteridophytes (12 species) followed by shrubs (7 species) and trees (5 species) while 1 species of gymnosperm tree to the grove. In angiosperm, dominant family was Rosaceae with 5 species followed by Asteraceae (4 species), Rubiaceae (3 species), etc, while in pteridophyte, Polypodiaceae (4 species) and lichen Parmeliaceae (11 species).

Table 1. Phytodiversity of Dhwaj sacred groves.

| S. No. | Botanical Name of Plants | Family          | Habit (life form) |
|--------|--------------------------|-----------------|-------------------|
| 1      | Anaphalis contorta (D. Don.) Hook.f. | Asteraceae       | Herb              |
| 2      | Anaphalis margaritacea (L.) Benth. | Asteraceae       | Herb              |
| 3      | Anaphalis triplinervis (Sims) C.B. Clarke | Asteraceae       | Herb              |
| 4      | Berberis asiatica Roxb. ex DC | Berberidaceae    | Shrub             |
| 5      | Berberis chitri Lindl.      | Berberidaceae    | Shrub             |
| 6      | Bergenia ciliata (Haw.) Sternb. | Saxifragaceae    | Herb              |
| 7      | Bistorta amplexicaulis (D. Don) Greene | Polygonaceae      | Herb              |
8. *Carpesium cernuum* L. | Asteraceae | Herb
9. *Cyanthula tomentosa* (Roth) Moq. | Acanthaceae | Herb
10. *Cynodon dactylon* (L.) Pers. | Poaceae | Herb
11. *Dipsacus inermis* Wall. | Dipsacaceae | Herb
12. *Duchesnea indica* (Andr.) Focke | Rosaceae | Herb
13. *Erigotis nigra* Nees ex Steud. | Apiaceae | Herb
14. *Flemingia strobilifera* (L.) R. Br. | Fabaceae | Herb
15. *Galium aparine* L. | Rubiaceae | Herb
16. *Galium asperifolium* Wall. ex Roxb. | Rubiaceae | Herb
17. *Geranium wallichianum* D. Don ex Sweet. | Geraniaceae | Herb
18. *Goldfussia dalhousiana* Nees | Acanthaceae | Herb
19. *Goodyera hemasalyna* Nees | Orchidaceae | Herb
20. *Hedychium spicatum* Sm. | Zingiberaceae | Herb
21. *Impatiens balsamina* L. | Balsaminaceae | Herb
22. *Myrica esculenta* Buch.-Ham. ex D. Don | Myricaceae | Tree
23. *Oxalis corniculata* L. | Oxalidaceae | Herb
24. *Prinsepia utilis* Royle | Rosaceae | Shrub
25. *Pyracantha crenulata* (Roxb.) M. Roem. | Rosaceae | Shrub
26. *Quercus leucotricophora* A. Camus | Fagaceae | Tree
27. *Rhododendron arboreum* Sm. | Ericaceae | Tree
28. *Rubia manjith* Roxb. | Rubiaceae | Climber
29. *Rubus ellipticus* Thunb. | Rosaceae | Shrub
30. *Rubus niveus* Thunb. | Rosaceae | Climber
31. *Rumex hastatus* D. Don | Polygonaceae | Herb
32. *Scutellaria scandens* Buch.-Ham. ex D. Don | Lamiaceae | Herb
33. *Smilax aspera* L. | Smilacaceae | Climber
34. *Solanum nigrum* L. | Solanaceae | Herb
35. *Swerita cordata* (G. Don) Wall. ex Clarke | Gentianaceae | Herb
36. *Thalictrum foliolosum* DC. | Ranunculaceae | Herb
37. *Valeriana jatamansi* Jones | Valeriacae | Herb
38. *Viburnum cotonifolium* D. Don | Caprifoliaceae | Tree
39. *Viburnum mullah* Buch.-Ham. ex D. Don | Caprifoliaceae | Tree
40. *Woodfordia fruticosa* (L.) Kurz | Lythraceae | Shrub

**Gymnosperm**
41. *Capressus tortolusa* D. Don | Cupressaceae | Tree

**Pteridophyte**
42. *Osmunda regalis* L. | Osmundaceae | Fern-aliess
43. *Adiantum venustum* D. Don | Adiantaceae | Fern
44. *Adiantum lunulatum* Burm. | Adiantaceae | Fern
45. *Lygodium flexuosum* (L.) Swartz | Lygodiaceae | Fern
46. *Selinaria bryopteris* (L.) Bak. | Selaginellaceae | Fern-aliess
47. *Selaginella indica* (Milde) Trayon | Selaginellaceae | Fern-aliess
48. *Pyrrhosa flocculosa* (Don) Ching | Polyodiaceae | Fern
49. *Oleandra wallichii* (Hook.) Presl. | Oleandraceae | Fern
50. *Onychium lucidum* (Don.) Spr. | Cryptogrammaceae | Fern
51. *Drynaria mollis* Bedd. | Polyodiaceae | Fern-aliess
52. *Drynaria proppingua* (Wall. ex Mett.) Smith | Polyodiaceae | Fern-aliess
53. *Microsorum membranaceum* (D. Don) Ching | Polyodiaceae | Fern-aliess

**Bryophyte**
54. *Bryosedgwickia aurea* (Schwaegr.) Fleisch. | Sematophyllaceae | Pleurocarpus
55. *Campylopus goughii* (Mitt.) Jaeg. | Dicranaceae | Pleurocarpus
56. *Marchantia palaeacea* Bert. | Marchantiaenceae | Pleurocarpus
57. *Meteorium buchananii* (Brid.) Broth. | Meteoriaceae | Acrocarpus
58. *Plagiochasma appendiculatum* Lehm et Lindenb | Aytoneaceae | Pleurocarpus
59. *Thuidium assimile* (Mitt.) Jaeg. | Thuidiaceae | Acrocarpus
60. *Trachypodopsis serrulata* (P. Beauv.) Fleisch. | Trachydiaceae | Pleurocarpus

**Lichen**
61. *Arthothelium abnorme* (Ach.) Müll.- Arg. | Arthoniaceae | Crustose
62. *Balbothrix isidiza* (Nyl.) Hale | Parmeliaceae | Foliose
63. *Balbothrix setschwanensis* (Zahlbr.) Hale | Parmeliaceae | Foliose
64. *Canomaculina subtinctoria* (Zahlbr.) Elix | Parmeliaceae | Foliose
65. *Canoparmelia eurperuta* (Mull.-Arg.) Elix & Hale | Parmeliaceae | Foliose
Species composition and distribution

This sacred grove is covered by dense forest canopy of *Rhododendron arboreum* Sm. and *Quercus leucotrichophora* A. Camus trees representing moist sub-temperate type forest. *Rhododendron arboreum* Sm. was found to be the most dominant tree species representing highest density (55) and Importance Value Index (IVI) (69.77926) followed by *Quercus leucotrichophora* A. Camus, *Myrica esculenta* Buch.-Ham. ex D. Don, *Cupressus tortolusa* Griff., etc (Table 2; Fig. 3). Some herbaceous species viz., *Dipsacus inermis* Wall., *Goodyera hemsleyana* King & Pantl., *Lygodium flexuosum* (L.) Sw. are found regularly with high AF value while some are with low AF values. Herbaceous plant species are regularly or randomly distributed all along the grove in which *Pyrosis flocculosa* (D. Don) Ching (fern) was found to be the most dominant species with highest density and IVI followed by angiospermic plant species such as *Ghingaroo* (fern) was found to be the most dominant species with highest density and IVI followed by angiospermic plant species such as *Duchesnea indica* (Jacks.) Focke, *Bergenia ciliata* (Haw.) Sternb., etc. According to A/F value, most of the plant species are distributed regularly of 51% while some are 26% randomly and 23% species were contagiously distributed. Regular distribution of species at study site was almost negligible in case of tree and shrub while 100% shrub species contagiously distributed.

Table 2. List of ethno-medicinal plants used by the local community of Dhwaj sacred grove.

| S.No. | Scientific Name | Family | Local Name | Part used | Ethno-medicinal Uses |
|-------|----------------|--------|------------|-----------|----------------------|
| 1.    | *Anaphalis marginata* (L.) Benth. | Asteraceae | - | Whole plant | Cold and cough |
| 2.    | *Berberis asiatica* Roxb. ex DC | Berberidaceae | Kilmora | Root/Stem | Fever, diabetes |
| 3.    | *Berberis chintha* Ham. ex Ker. | Berberidaceae | Kingore | Root/Stem/Fruits | Fever, stomach problem |
| 4.    | *Bergenia ciliata* (Haw.) Sternb. | Saxifragaceae | Patarcattha/patarchur | Rhizome | Kidney stone, tonic |
| 5.    | *Catha tomentosa* Miq. | Acanthaceae | Letkura/Katari | Leaves | Skin diseases |
| 6.    | *Cynodon dactylon* (L.) Pers. | Poaceae | Doob | Whole plant | Fever, tonic |
| 7.    | *Eragrotis nigra* Nees ex Steud. | Poaceae | - | Root | Tonic |
| 8.    | *Flemingia strobilifera* (L.) R. Br. | Fabaceae | Salpani/Bhadula | Whole plant | Fever, bronchial problem |
| 9.    | *Galium aparine* L. | Rubiaceae | - | Root/stem | Tonic |
| 10.   | *Geranium wallichianum* D. Don ex Sw. | Geraniaceae | Bhanda/Bheeljadhi | Whole plant | Fever, liver problem |
| 11.   | *Hedychium schapat* Buch.-Ham. ex Sm. | Zingiberaceae | Van haldu | Rhizome | Cold, cough, tonic, asthma, gastric problem, liver diseases, fever. |
| 12.   | *Myrica esculenta* Buch.-Ham. ex D. Don | Myricaceae | Kaphal | Fruits & stem bark | Stomach problem |
| 13.   | *Oxalis corniculata* L. | Oxalidaceae | Chilmori | Whole plant | Piles |
| 14.   | *Bistorta amlexcaulis* (D. Don) Greene | Polygonaceae | Kutrya | Root | Tonic, cough |
| 15.   | *Princesia utilis* Royle | Rosaceae | Bhekal | Seeds | Skin disease |
| 16.   | *Pyracantha chenulata* (D. Don) Roem. | Rosaceae | Gingaroo | Fruits | Stomach disorder |


**Ethno-medicinal plants**

For the collection data related to ethno-medicinal plants, 16 persons are interviewed out of which 10 informants (7 males and 3 females) are respondent. The other informants have kept their medicinal plant knowledge secret and formally transferred along the family line i.e., from father/mother to child mainly a so.

A total 40 ethno-medicinal plants, angiosperm represents 27 species belonging to 26 genera and 19 families, 1 species in 1 genus and 1 family of gymnosperm, 4 species in 3 genera and 3 families of pteridophyte, 3 species under 3 genera and 3 families of bryophytes and 5 species under 5 genera and 1 family of lichen were reported and used in various ailments (Table 3).

**Table 3.** List of RET taxa present in the grove.

| S. No. | Scientific Plant Name | Family       | Status          |
|--------|------------------------|--------------|-----------------|
| 1      | Valeriana jatamansi Jones | Valerianaceae | Vulnerable      |
| 2      | Bergenia ciliata (Haw.) Sternb. | Saxifragaceae | Vulnerable      |
| 3      | Berberis asiatica Roxb. ex DC. | Berberidaceae | Critically endangered |
| 4      | Hedychium spicatum Sm. | Zingiberaceae | Vulnerable      |
| 5      | Swertia cordata (Wall. ex G. Don) C.B. Clarke | Gentianaceae | Vulnerable      |
| 6      | Goodyera hemsleyana King & Pantl. | Orchidaceae | Critically endangered |
| 7      | Myrica esculenta Buch.-Ham. ex D. Don | Myricaceae | Vulnerable      |
| 8      | Osmunda regalis L. | Osmundaceae | Threatened      |

**Associated plant species**

Trees like *Rhododendron arboreum* Sm., *Quercus leucotrichophora* A. Camus, *Myrica esculenta* Buch.-

www.tropicalplantresearch.com

558
Figure 3. Showing various life forms in the Dhwaj sacred grove with their frequency, density and abundance: A, Tree species of sacred grove; B, Shrub species of sacred grove; C, Herb species of sacred grove.
Singh & Kumar 2020

Ham. ex D. Don, Viburnum cotinifolium D. Don and Viburnum mullaha Buch.-Ham. ex D. Don makes dense canopy inside the grove and providing shelter to many shade loving plants. Rhododendron arboreum Sm., Dipsacus inermis Wall., Bergenia ciliata (Haw.) Sternb. and Geranium wallichianum D. Don ex Sweet are the most beautiful flowers bearing plants during the flowering seasons (February to October) in the grove (Fig. 4). Phytodiversity includes all life and growth forms (both lower and higher plant species), which are playing pivotal role in balancing any ecosystem. Plant like Goodyera hemsleyana King & Pantl., Bergenia ciliata (Haw.) Sternb., Valeriana jatamansi Jones, Hedychium spicatum Sm. (Angiosperm); Adiantum venustum D. Don, Lygodium flexuosum (L.) Sw. (Pteridophyte); Bryosedgwickia aurea (Schwagr.) M. Fleisch., Campylopus goughii (Mitt.) A. Jaeger (Bryophytes); and Punctelia radicina (Ach) Krog (Lichens) need humus rich soil, moist conditions, optimum temperature (15–25°C) and sufficient light for their luxuriant growth and all these micro-climatic conditions available in this sacred grove. Occurrence of Bistoria amplexicaulis (D. Don) Greene, Valeriana jatamansi Jones, Swertia cordata (Wall. ex G. Don) C. B. Clarke, Bergenia ciliata (Haw.) Sternb., Goodyera hemsleyana King & Pantl., Hedychium spicatum Sm., etc. indicates the good micro-climatic conditions in the grove. Climbers, Smilax aspera L., Galium asperifolium Wall. and Rubia manjith Roxb. ex Fleming are hanging in different substratum of trees and shrubs. A parasitic plant species Cuscuta reflexa Roxb. is climbing on Pyracantha crenulata (Roxb. ex D. Don) M. Roem. and Berberis asiatica Roxb. ex DC. which is also contributing unique habitat for phytodiversity of the grove.

![Figure 4. Beautiful flowers of the sacred grove: A, Bergenia ciliata (Haw.) Sternb.; B, Hedychium spicatum Sm.; C, Valeriana jatamansi Jones; D, Rhododendron arboreum Sm; E, Dipsacus inermis Wall.; F, Geranium wallichianum D. Don ex Sweet.](image)

Cretaceous shrubs, Berberis asiatica Roxb. ex DC. and Pyracantha crenulata (Roxb. ex D. Don) M. Roem. provides excellent substratum for epiphytic lichens and mosses. Lichen like Usnea pseudosinensis Asahina and Ramalina conduplicans Vain. are growing epiphytically on branches of Pyracantha crenulata (Roxb. ex D. Don) M. Roem., Berberis asiatica Roxb. ex DC., etc. Canoparmelia caperata (Mull. Arg.) Elix & Hale and Cetreria cetrarioides (Duby) W. Culb. & C. Culb. are mostly growing on the substratum of Rhododendron arboreum Sm. and Quercus leucotrichophora A. Camus. Bryophytes like Marchantia paleacea Bertol. and Plagiochasma appendiculatum Lehm & Lindenb. are growing on moist rock. Pteridophytes like Adiantum venustum D. Don, A. lunulatum Burn. f., Osmunda regalis (L.), Selaginella bryopteris (L.) Baker, are found on the moist rocks along the water reservoir. Pyrrosia flocculosa (D. Don) Ching and Drynaria mollis Bedd. are found epiphytically on the bark and branches of Quercus leucotrichophora A. Camus.

Traditional beliefs

In this sacred grove, the local community is much feared to the deity ‘Maa Jyanti’. The deity of the grove is very ferocious and all forms of vegetation in such a sacred grove are under the protection of the reigning deity of that grove, and the removal, even of deadwood, is taboo. These strong traditional beliefs can help to conserve the biodiversity of the area day by day with the fear of deity reside in them. The villagers would not dare to enter this forest for fear of angering the resident deity. In this way, these habitats are more sensitive to the

www.tropicalplantresearch.com
effects of modification than others, and hence avoidance or mitigation of such habitat change can be a form of conservation.

Cultures and folk taboos in the sacred grove

A. The whole grove is governing by the local customs used by the surrounding communities and nearby villagers.

B. Collection of fuel, fodder is strictly prohibited, even a falling twigs and leaves on the ground of these sacred patches. Only certain cases, the villagers enter in these groves on the occasions of annual festivals.

C. Women are strictly prohibited from entering sacred forest during menstrual cycle and pregnancy.

D. The lower castes are debarred to enter the sacred forests, only by the permission of the local authorities.

E. Before entering in sacred groves, the people stop taking onion, garlic, egg and meat.

DISCUSSION

Dhwaj sacred grove is a good example of strong traditional beliefs and taboos by the local people to conserve biodiversity. This grove is present at an altitude of 2200 m and a treasure house of many threatened flora of the Himalayan region. The grove has a high number of species in a small area similar studies are also seen in the same region (Agnihotri et al. 2009, Sukumaran et al. 2018). In angiosperm, the dominant family was Rosaceae followed by Asteraceae, Rubiaceae, etc. while in pteridophyte, Polypodiaceae and in lichen Parmeliaceae, etc. which represents the good environment of the grove. Among the 81 species, Berberis ciliata (Haw.) Sternb., Berberis asiatica Roxb. ex DC., Hedychium spicatum Sm, Svertia cordata (Wall. ex G. Don) C. B. Clarke and Valeriana jatamansi Jonesare some potential threatened medicinal and aromatic plants in the grove (Sammant et al. 1998, Arya & Agarwal 2006).

For ethnobotanical studies, the majority of the informants reported that they keep their medicinal plant knowledge secret and formally transferred along the family line i.e. from father/mother to child mainly a son also reported by other researchers (Sharma et al. 1992, Gedif & Hahn, 2002, Uniyal et al. 2006, Panghal et al. 2010, Bajpai et al. 2016, Gadhvi & Modi 2019, Ahmed et al. 2020).

Presence of water in the grove is due the dense forest of Quercus leucotrichophora A. Camus (Adhikari & Adhikari 2007) which is responsible for luxuriant growth of Adiantum venustum D. Don, A. lumulatum Burm., etc. and other water-loving plants. Lichens are the bio-indicator and presence of certain lichens indicates the forest type of the region viz., luxuriant growth of Usnea pseudosinensis Asahina, Ramalina conduplicans Vain. and Lobaria retigera (Bory) Trevis. in the grove represents the presence of smooth barked trees and evergreen forest type where the environment is fresh while the presence of Lecanora achatia Nyl., Lecanora japonica Müll. Arg. represent the well illuminated environmental conditions in the grove (Singh & Husain 2012). Due to presence of dense canopy of Rhododendron arboreum Sm. which was found most dominant tree species representing highest density and IVI 69.77926 followed by Quercus leucotrichophora A. Camus, Myrica esculenta Buch.-Ham. ex D. Don, etc which is represented moist and temperate type forest which was also matched with other studies. Fern-like Pyrrosia flocculosa (D. Don) Ching was found to be the most dominant herbaceous species with highest density and IVI in the grove showing their dense presence in such environment.

The deity of the grove is very ferocious in nature and all forms of vegetation in such a sacred grove are under the protection of the reigning deity and the removal, even of deadwood, is taboo (Singh et al. 2010).

CONCLUSIONS

The exclusive taxa are found refuge in the micro-climatic conditions of the grove, which does not only connect the species to the ecosystem but also related to socio-cultural aspects which result conserved and reservoir of biodiversity. The case of Dhwaj sacred grove shows that it is functioning as a rich storehouse of bio-diversity and is managed by local communities which preserve their natural forest for the future generation. Indian Himalaya is a place of god with varied sacred groves maintained by different tribal and non-tribal communities having many rare and endangered flora and fauna. Loss of such grove adversely affects the environment and consequently, imbalance our ecological balance. Many plant species are endemic and threatened to this grove only, it is essential that this grove immediately brought under protected area network to ensure the protection of such plants and animals and their habitat. Management of existing village and community forests may be improved through adequate funding to village durbars and through appropriate management interventions by the government using a participatory approach. This will help in meeting the biomass needs of the villagers, which in turn will reduce the anthropogenic pressures on sacred groves. Nursery techniques, both ex-situ and in-situ conservation and management must be taken for the native and threatened...
species that are confined to sacred groves and such species should be planted in nearby village reserve forests and in the degraded sacred grove areas. There is a need to convert the traditional beliefs of the tribal people into effective conservation values behind the beliefs that need to be explained to the villagers. The only occasion these areas are accessed, with minimal invasion, is during annual Dhwaj festival in August. Tourism, collection of medicinal plants, fire, fuel, fodder and grazing are some anthropogenic pressures which are causing a serious threat to the rich forest of Dhwaj sacred grove.

ACKNOWLEDGEMENTS

Authors are grateful to the Director of CSIR-National Botanical Research Institute, Lucknow, for facilities. The authors also thankful to lichenologist Dr. D.K. Upreti and Dr. A.K. Asthana, CSIR-NBRI, Lucknow for help in identifying lichens and bryophytes. Finally, to the local communities whose support was impressive during collecting indigenous knowledge and plants.

REFERENCES

Adhikari SD & Adhikari BS (2007) Veneration of a Deity by Restoration of sacred grove in a Village Minar, Kumaun Region of Uttarakhand: A Case Study. *Journal of American Science* 3(2): 45–49.

Agnihotri P, Husain T & Singh H (2009) Nakuleshwar: a newly discovered sacred grove from Pithoragarh district. *Science & Culture* 75: 42.

Agnihotri P, Sharma S, Singh H, Dixit V & Husain T (2010) Sacred groves from Kumaon Himalaya. *Current Science* 99(8): 996–997.

Ahmed IM, Tahir YF, Nour SM & Suliman MA (2020) Traditional use of medicinal plants among the Barti tribe community in Fangroga area, Sennar State, Sudan. *Tropical Plant Research* 7(2): 517–521.

Arya KR & Agarwal SC (2006) Conservation of threatened medicinal and folklore plants through cultivation in Uttarakhand state. *Ethnobotany* 18: 77–86.

Awasthi DD (1991) A key to the microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenologica* 40: 1–337.

Awasthi DD (2007) *A Compendium of the Macrolichens from India, Nepal and Sri Lanka*. Dehra Dun: Bishen Singh & Mahendra Pal Singh.

Bajpai O, Pandey J & Chaudhary LB (2016) Ethnomedicinal uses of tree species by Tharu tribes in the Himalayan Terai region of India. *Research Journal of Medicinal Plant* 10(1): 19–41.

Berkes F (1999) *Sacred Ecology: Traditional Ecological Knowledge and Resource Management*. Philadelphia: Francis & Taylor.

Cottam G & Curtis JT (1956) The Use of Distance Measurements in Phytosociological Sampling. *Ecology* 37: 451–460.

Curtis JT & McIntosh RP (1950) The Interrelations of Certain Analytic and Synthetic Phytosociological Characters. *Ecology* 31: 434–455.

Daba D & Asfaw B (2020) Ethnobotanical study on the medicinal value of selected five species in Gullele Botanic Garden and its surroundings. *Tropical Plant Research* 7(2): 285–295.

Deepa MR, Sheema Dharmapal P & Udayan PS (2016) Floristic diversities and medicinal importance of selected sacred groves in Thrissur district, Kerala. *Tropical Plant Research* 3(1): 230–242.

Deepa MR, Udayan PS & Anilkumar KA (2017) Taxonomical and phytosociological studies on Chithalikavu-A sacred grove, Thrissur district, Kerala. *Tropical Plant Research* 4(1): 20–30.

Gadgil M & Chandran MDS (1992) Sacred groves. *India International Centre Quarterly* 19 (1–2): 183–187.

Gadgil M & Vartak VD (1975) Sacred groves of India: A plea for continued conservation. *Journal of Bombay Natural History Society* 72: 314–320.

Gadhvi KJ & Modi NR (2019) Traditional ethnomedicinal plants used by tribal communities in Godhra forest, Gujarat, India. *Tropical Plant Research* 6(3): 506–513.

Gaur RD (1999) *Flora of district Garhwal northwest Himalaya (with ethonobotanical notes)*. TransMedia, Srinagar Garhwal, India, 811 p.

Gedi T & Hahn HJ (2002) Epidemiology of herbal drugs use in Addis Ababa, Ethiopia. *Pharmacoepidemiology and Drug Safety* 11(7): 587–591.

Ghildiyal JC, Bisth S & Jadi R (2008) A contribution to the biological diversity of Tarkeshwar Sacred grove in Garhwal Himalayas. *Indian Forester* 135: 789–800.

Greig-Smith P (1983) *Quantitative plant ecology*. University of California, Berkeley and Los Angeles, 354 p.
Gupta AN (1968) *Paradiplangus indicus* sp. nov. (Trematoda: Digenea: fam. Callodistomidae Poche, 1926) from *Tetradon viridipunctatus* (Gunther) from India. *Rivista di Parassitologia* 29: 17–20.

Jain SK & Rao RR (1977) *A Handbook of Field and Herbarium Methods*. Today and Tomorrow’s Printers, New Delhi.

Khan ML, Khumbongmayum AD & Tripathi RS (2008) The Sacred groves and their significance in conserving biodiversity: an overview. *International Journal of Ecology and Environmental Sciences* 34 (3): 277–291.

Krebs CJ (1989) *Ecological methodology*. New York, NY: Harper and Row Publishers Inc., 654 p.

Martinez D (1996) *First people, firsthand knowledge*. *Sierra* 81(6): 50–51.

Mehra A, Bajpai O & Joshi H (2014) Diversity, utilization and sacred values of Ethno-medicinal plants of Kumaun Himalaya. *Tropical Plant Research* 1(3): 80–86.

Mgumia FH & Oba G (2003) Potential role of sacred groves in Biodiversity conservation in Tanzania. *Environmental conservation* 30(3): 259–265.

Naithani BD (1984) *Flora of Chamoli*, Vol-1. Howrah: Botanical Survey of India.

Negi CS (2005) Socio-cultural and ethnobotanical value of a sacred forest. ThalKedhar, Central Himalaya. *Indian Journal of Traditional Knowledge* 4(2): 190–198.

Negi CS (2010) Traditional Knowledge and Biodiversity Conservation: A preliminary study of the sacred Natural sites in Uttarakhand, Central Himalaya. *Journal of Biodiversity* 1(1): 43–62.

Ngbulou KN, Mhigo SO, Liyongo CI, Ashande MC, Tshibangu DST, Zoawe BG, Baholy R, Fatiany PR & Mpiana PT (2016) Ethno-botanical survey of plant species used in traditional medicine in Kinshasa city (Democratic Republic of the Congo). *Tropical Plant Research* 3(2): 413–427.

Osmaston AE (1927) *Forest flora for Kumaon*. Superintendent, Government Press, United Provinces, Allahabad, India, 605 p.

Panghal M, Arya V, Yadav S, Kumar S (2010) Indigenous knowledge of medicinal plants used by Saperas community of Khetawas, Hrajjar District, Haryana, India. *Journal of Ethnobiology and Ethnomedicine* 6(4): 4–11.

Raizada, MB & Saxena HO (1978) *Flora of Mussoorie*. Bishen Singh Mahendra Pal Singh, Dehradun.

Sammant SS, Dhar U & Palni LMS (1998) *Medicinal Plants of Indian Himalaya: Diversity Distribution Potential Values*. Gyanodaya Prakashan, Nainital.

Schaaf T (1998) Sacred groves in Ghana: Experiences from an integrated study project, In: Ramakrishnan PS, Saxena KG & Chandrashekara UM (eds) *Conserving the Sacred for Biodiversity Management*. UNESCO and Oxford-IBH Publishing, New Delhi, pp. 145–150.

Sharma MP, Ahmad J, Hussain A & Khan S (1992) Folklore medicinal plants of Mewat (Gurgaon Districts), Haryana, India. *International Journal of Pharmacognosy* 2: 129–134.

Singh H & Husain T (2012) Sacred groves of Kumaon Himalaya: an abode for lichens, *Phytotaxonomy* 12: 145–150.

Singh H, Husain T & Agnihotri P (2010) Haat Kali sacred grove, Central Himalaya, Uttarakhand. *Current Science* 10: 298–307.

Singh H, Husain T, Agnihotri T, Pande PC, & Khatoon S (2014) An ethnobotanical study of medicinal plants used in sacred groves of Kumaon Himalaya, Uttarakhand, India. *Journal of Ethnopharmacology* 154(1): 98–108.

Singh H, Husain T, Pande PC & Iqbal M (2012) Biodiversity conservation through traditional beliefs system: a case study from Kumaon Himalayas, India. *International Journal of Conservation Science* 3(1): 21–28.

Sinha B & Maikhuri RK (1998) Conservation through ‘Socio-cultural-religious practice’ in Gharhwal Himalaya: A case study of Hariyali sacred site. In: Ramakrishnan PS, Saxena KG & Chandrashekharita UM (eds) *Conserving the sacred for Biodiversity Management*. Oxford and IBH Publishing C. Pvt. Ltd., New Delhi, pp. 289–299.

Sukumaran S, Pepsi A, Siva Prades DS & Jeeva S (2018) Phytosociological studies of the sacred grove of Kanyakumari district, Tamilnadu, India. *Tropical Plant Research* 5(1): 29–40.

Tiwari BK, Barik SK & Tripathi RS (1999) Sacred groves of Meghalaya, *Biological and cultural diversity*, Published by Regional Centre National Afforestation and Eco-Development Board North-Eastern Hill University, Shillong.

Uniyal SK, Singh KN, Jamwal P & Lal B (2006) Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. *Journal of Ethnobiology and Ethnomedicine* 2(1): 14–21.
Vartak VD & Gadgil M (1973) Studies on sacred groves along the Western Ghats from Maharashtra and Goa; Role of beliefs and folklores. In: Jain SK (ed) *Glimpses of Indian Ethnobotany*. Oxford & IBH, New Delhi, 272–278.

Vartak VD (1983) Observation on rare imperfectly known and endemic plants in the sacred groves of Western Maharashtra. Jain SK & Rao RR (ed) *An assessment of threatened plants of India*. BSI publ. Howrah, pp. 169–178.

Vecsey C (1980) American Indian environmental religions. In: Vecsey CT & Venables RW (eds) *American Indian Environments: Ecological Issues in Native American History*. Syracuse: Syracuse University Press, pp. 1–37.