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Inventory of ethnobotanicals and other systematic procedures for regional conservation of medicinal and sacred plants

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Abstract The plant diversity of western Madhya Pradesh is reducing at the fast rate due to anthropogenic disturbances and environmental degradation. Disturbance is a major factor responsible for the fragmentation of forest vegetation; as a result, there is a preponderance of small patches, and some of them are still preserved as sacred groves because of strong religious beliefs held by the indigenous people of Jhabua district of western Madhya Pradesh. Dungari mata sacred grove is situated near Kathiwada village in Jhabua district of western Madhya Pradesh that considered being residence of local deities. The *Bhil* and *Bhilala* are the most dominant tribe of the study area and depend upon the forest resources for their livelihood. About 339 species, 286 genera and 82 families were found in the grove. Fabaceae (38 species), Poaceae (33 species) and Asteraceae (20 species) were dominant families, and the *Ipomoea* was the largest genus, with five species. About 69 tree species, 25 shrubs, 157 herbs, 40 grasses, 3 epiphytes and 45 climbers and lianas were found in the groves. Some threatened plant species are growing over here that are not found elsewhere, and they comes under various threat categories. About threatened taxa, 81 species were recorded from the grove that comes under various threat categories. The present status of the grove is of concern, as it is gradually declining under constant anthropogenic pressure. Their better management and protection are important for the conservation of plant diversity in the region and also for the benefit of indigenous tribes of the state.

Keywords Ethnobotany · Conservation status · Dungari mata sacred grove · *Bhil* and *Bhilala*

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1 Introduction

Sacred groves are forest patches rich in biodiversity, manifested by a range of traditions and cultural values of the indigenous people who protect the groves with the belief in nature worship inherited from their ancestors. They act as reservoir of much local biodiversity preserving unique flora and fauna. Sacred groves are the repositories of rare and endemic species and can be regarded as the remnant of the primary forest left untouched by the local inhabitants and protected due to the belief that the deities reside in these forests. 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 (1975) have traced this historical link of the sacred groves to the pre-agricultural, hunting and gathering societies. Hughes and Chandran Subash (1997) have presented an overview on the distribution of sacred groves around the earth in Asia, Africa, Australia, Europe and America.

In India, sacred groves are found mainly in tribal dominated areas and are known by different names in

ethnic terms (Bhakat 1990). About 4,215 sacred groves covering an area of 39,063 hectares are estimated to be distributed in India (Malhotra 1998). Many scholars have been working on conservation of sacred groves through sociocultural practices (i.e. religious, cultural value, health, economic value, psychological and education) in different parts of India (Gadgil and Vartak 1975, 1976; Boojh and Ramakrishan 1983; Khiewtam and Ramakrishnan 1989; Rodgers 1994; King-Oliver et al. 1997; Tiwari et al. 1998a; Sinha and Maikhuri 1998; Sunitha and Rao 1999; Kushalapa et al. 2001). The sacred groves are considered to be a rich source of medicinal, rare and endemic plants as refugia for relic flora of a region and as centre of seed dispersal (Whittaker 1975; Jeeva et al. 2006). Medicinal plants constitute the base of the healthcare system in many societies. Globally, about 85 % of the traditional medicines used for primary health care derived from plants (Farnsworth 1988). Today, according to the World Health Organization (WHO), as many as 80 % of the world's people depend on traditional medicine and in India, 65 % of the population in the rural areas use Ayurvedic and medicinal plants to help meet their primary healthcare needs (WHO Status Report 2002–2005). In India, more than 43 % of the total flowering plants are reported to be of medicinal importance (Pushpangadan 1995).

In Madhya Pradesh, work on floristic, ethnobotany and conservation has been done in some regions by Jain (1978), Jain and Vairale (2001), Jain and Patole (2007), Dhingra (1986), Sikarwar (1990), Patole (2002), Samvatsar (1996), Kadel (2006), Kadel and Jain (2006), Jain et al. (2011), Wagh and Jain (2014a, b). Despite the vast and varied flora of western Madhya Pradesh, the biodiversity of the sacred groves with reference to ethnomedicinal uses has not been explored sufficiently. The objective of the present research work is to study the floristic diversity, documentation of ethnomedicinal uses and threat assessment of the medicinal plants in Dungari mata sacred grove and discusses their importance in the conservation of regional plant diversity.

2 Methodology

2.1 Inventory of sacred groves

An extensive field survey was undertaken to inventory the sacred groves of Jhabua district, Madhya Pradesh, during 2007–2013. Traditional institutes such as village headmen, *Bhil* and *Bhilala* (priests and priestesses or the local medicine men and women, respectively), and local people, educated persons, caretakers of the sacred groves, etc. were contacted for identifying sacred groves in the territories under their control or in their knowledge. Data on sacred groves were collected from them through informal and formal interviews and by observing the groves. The identified groves were listed accordingly. Most of the sacred 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 or caretaker of the grove and through measurement based on an imaginary line or boundary (using the knowledge of the caretaker or village headman or some authentic person) around the grove. We conducted inventories for a total of four sacred groves from the Jhabua district of western Madhya Pradesh. Based on the inventory and preliminary survey, one sacred grove i.e. Dungari mata sacred grove was selected from the Jhabua districts for the purpose of detailed studies on floristic composition, ethnobotanical importance and threatened taxa point of view. Its selection was done taking into consideration its size, vegetation and location. The location of the selected sacred grove is shown on the map of Madhya Pradesh (Fig. 1). The indigenous people believe that their deities live inside these sacred groves. They also believe that these deities would be offended if any damage is caused to the plants and animals residing in these groves. Hence, nobody collects anything from these localities, not even fallen branches of trees.

2.2 Study site

Dungari mata sacred grove is situated near Katthiwada village in Jhabua district of western Madhya Pradesh that is believed to be the residence of local deities (Figs. 2, 3). Most of the village inhabitants of Katthiwada village belong to tribal communities like *Bhil, Bhilala* and *Pataya*. Out of these tribes, *Bhil* and *Bhilala* stand high in majority. The *Bhil* is one of the most important and the third largest tribe of India. The name has been derived from Dravidian word bil or vil meaning bow because they always keep a bow and arrow for hunting. Traditionally, the tribal communities in Jhabua district have been preserving small patches of virgin forest since time immemorial due to their religious belief. *Bhil* and *Bhilala* tribes live close to the forest and are largely dependent on the wild biological resources for their livelihood. They consume leaves, flower, corm, fruits, rhizome and bulbs, which are considered by the tribesmen as highly nutritional with high medicinal value.

2.3 Climate

Jhabua district mostly experiences variability in rainfall. The monsoon season from June to September is considered to be the growth period for natural vegetation. During postmonsoon season of October to November, a majority of the plants in natural vegetation bear flowers and fruits.

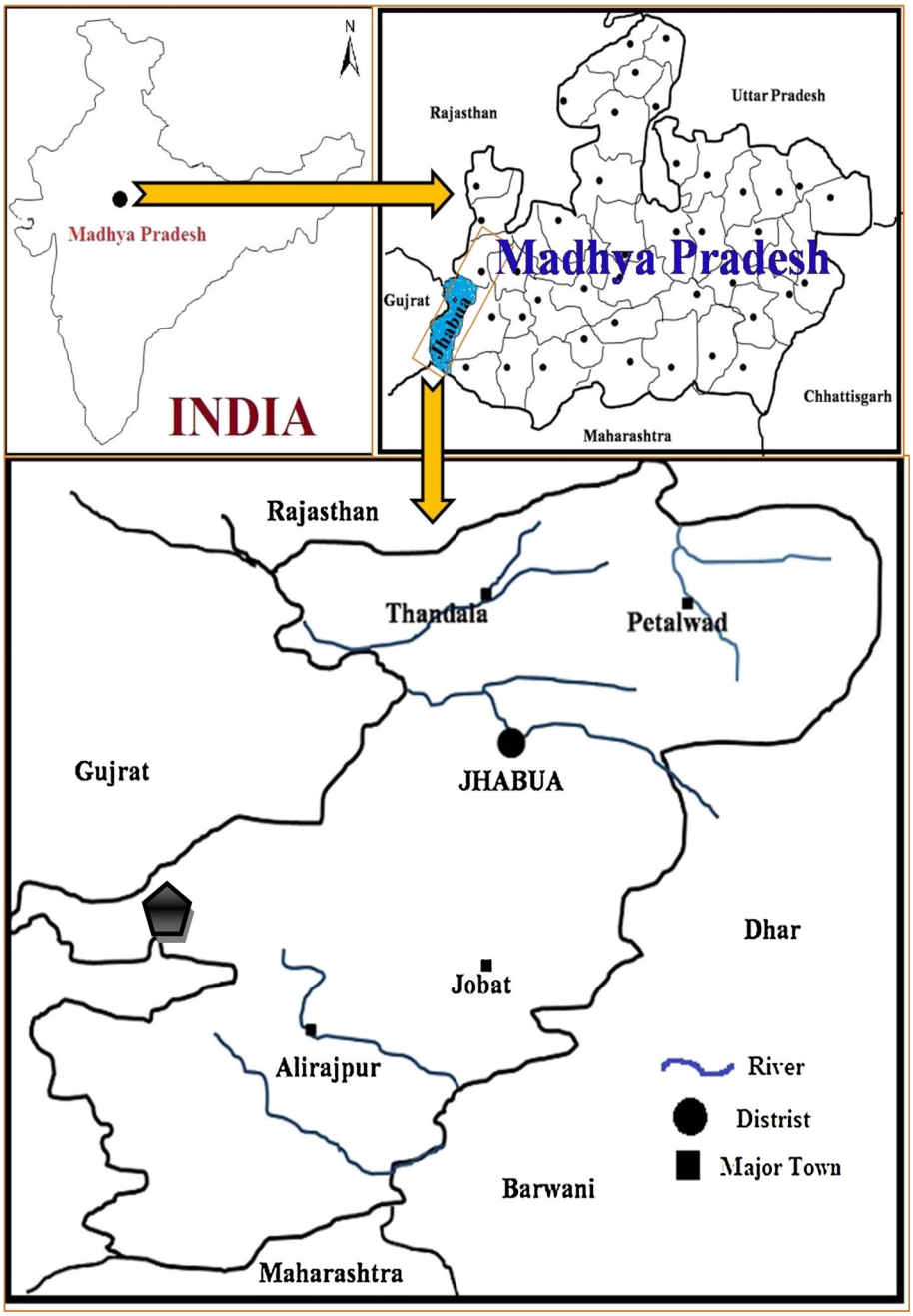

Fig. 1 Map of Jhabua district showing location of the sacred grove

Though rainfall is minimal in the winter season, it is very important for crops and greenland vegetation. This is the period of maturation and drying up of natural vegetation, generally grasses and herbaceous plants. During summer season of March to May, there is a continuous rise of temperature and decrease in pressure in the Indian sub-continent due to the heating effect of the Sun. In March, the highest mean daily maximum temperature of about 37 °C occurs over the Deccan plateau. Winds over north-west India are westerly and strong during the day and weak and variable during the night.

2.4 Collection, identification and deposition ethnomedicinal plants

The present work is the result of 6-year intensive study of the angiosperm diversity and threatened taxa of the Dungari mata sacred grove. Field trips were made to the selected sacred grove regularly, particularly to collect the plants during flowering and fruiting stages. Materials of some species like seeds, bark, leaves, stems, fruits, corms, roots, etc. were also collected. The plants not found in sufficient population were not collected and left for

Fig. 2 View of Dungari mata sacred grove

Fig. 3 Deities in the sacred grove

conservation. The herbarium specimens of plants and samples of raw materials were preserved and numbered. The plant specimens were dried and pressed in the field and taken to the laboratory, and a herbarium was prepared according to the customary methods (Lawrence 1951; Martin 1995). These plant specimens were critically studied and identified with the help of various floras and published literature (Hooker 1872–1897; Cooke 1901–1908; Duthie 1903–1929; Verma et al. 1993, Khanna and Kumar 2000, 2006). Final identification was made at the herbarium of CSIR-National Botanical Research Institute, Lucknow, and deposited in the herbarium of School of Studies in Botany, Jiwaji University, Gwalior.

2.5 Ethnobotanical observations

Tribals are secretive by nature. They do not want to communicate openly with strangers. They would not even allow taking of their photographs. Because of this, frequent visits to tribal villages were made. After three to four visits, the tribals mingled with one another and agreed to communicate with us. Several field trips were carried out in the study area to document the information on plants and their uses. Photographs of tribals were taken only after seeking their permission.

Methods adopted by various earlier workers were followed in the present work while collecting the ethnobotanical information (Raghavaiah 1956; Raizada 1966; Jain and Rao 1977; Jain 1988). Interview and discussions were carried out using a local dialect for easy communication with the participants. A total of 25 traditional healers, 17 men and 8 women, were interviewed to collect information on herbal preparations used by them for treating various diseases (Table 1).

2.6 Statistical analysis

2.6.1 Fidelity level (FL)

Fidelity level was calculated using the following formula:

$$\mathrm{FL}(\%) = \left\{\frac{Ip}{Iu}\right\} \times 100$$

where *Ip* is the number of informants who independently indicated the use of a species for the same major ailment and *Iu* the total number of informants who mentioned the plant for any major ailment (Friedman et al. 1986). The FL is useful for identifying the informant's most preferred plant species and its preparatory methods. FL values vary from 1.0 to 100 %. Generally, a FL of 100 % for a specific

Table 1 Socioeconomic characteristics of the study sample, $N = 25$

Socioeconomic variables	Number	%
Gender		
Male	17	68.00
Female	8	32.00
Age (years)		
16–25	1	04.00
26–35	4	16.00
36–45	2	08.00
46–55	3	12.00
56–65	6	24.00
66–75	7	28.00
76–85	2	08.00
>86	0	0.00

plant indicates that all of the use-reports record the plant being used the same way (Srithi et al. 2009).

2.6.2 *Informant's consensus factor (ICF)*

To estimate use variability of the medicinal plants and to determine which plants are particularly interesting in the search for bioactive compounds, the informant consensus factor (*F*ic; Heinrich et al. 1998) was calculated. This factor estimates the relationship between the "number of use-reports in each category (*n*ur) minus the number of taxa used (*n*t)" and the "number of use-reports in each category minus one". *F*ic is thus calculated using the following formula:

$$F\ \mathrm{ic} = \frac{n\mathrm{ur} - n\mathrm{t}}{n\mathrm{ur} - 1}$$

The product of this factor ranges from 0 to 1. A high value (close to one) indicates that relatively few taxa (usually species) are used by a large proportion of people, while a low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness.

2.7 Determination of threat status

Threat status of rare, endangered and other categories of plant species was analysed on the basis of the criteria suggested by (International Union of Conservation and Nature and Natural Resources IUCN 1994, 2005). The IUCN Red List Categories and Criteria are a system for classifying species at high risk of global extinction; it also provides an explicit, objective framework for the classification of the broadest range of species according to their extinction risk.

3 Results and discussion

3.1 Enumeration

The plant species collected from the sacred groves are presented in Table 2 as botanical name, voucher specimen number, family followed by local name, habit, plant part used, mode of administration, uses, fidelity level and threat categories.

3.2 Characteristics of plants used in curing various diseases

In total, 339 species of flowering plants which spreads in 286 genera and 82 families were collected and identified during the study period. Habit-wise analysis of flora shows that comparatively higher percentage of herbs (46.31 %) were predominant followed by trees (20.35 %), climbers and liana (13.27 %), grasses (11.7 %), shrubs (7.37 %) and epiphyte (0.88 %; Fig. 4). The frequent use of herbaceous species among the tribal communities could be a result of their relative abundance as compared to trees and shrubs as also witnessed by investigators of this study. The study area experiences tropical, subtropical and temperate humidity for most months of the year creating favourable condition for the growth of herbs. The common use of herbs as sources of medicine was also indicated by studies conducted elsewhere in the world (Muthu et al. 2006; Yineger et al. 2007). In the tropical regions, there is a tendency for few families of flora to dominate the pharmacopoeia; Fabaceae and Poaceae are two of such families. In the study of Upadhyay et al. (2010), Fabaceae and Poaceae were the most used families in the ethnomedicine system of Rajasthan. Musa et al. (2011) reported Fabaceae and Caesalpiniaceae as the most represented ethnomedicinal families in the savannah of Sudan. The plants of both Fabaceae and Poaceae are generally herbaceous in habit and can be cultivated or found in abundance in the nutrient poor soils of local forests. In the present study, Fabaceae (38 sps.) and Poaceae (33 sps.) were the dominant families (Fig. 5), and at genus level, *Ipomoea* represents the dominant genus with five sps. (Figure 6).

3.3 Fidelity level

This research classifies 39 species of plants with FLs 100 %, even without considering plants that were mentioned only once for better accuracy (Table 2). This information means that the informants had a tendency to rely on one specific plant species with one preparatory method than several preparatory methods.

3.4 Informant consensus factor (ICF)

There are totally 21 ailments of the dermatological disorder found in the study area. The most common ailments were cuts and wounds, septic wounds, eczema, scabies, pimples, swelling, ringworm, itching, boils and blisters. The values of informant consensus factor (ICF) were towards the higher side, i.e. more than 0.80. The highest ICF of 0.98 (2 species and 51 use-reports) was reported for eye diseases and lowest ICF of 0.25 for leucorrhoea (16 species and 21 use-reports). Joint disorders and skin disorders (22 species both), with number of species and (41) and (49) recorded ICF is 0.47 and 0.56, respectively (Table 3).

3.5 Ethnobotanical importance

The present study revealed that the local people living nearby the sacred grove were using all the represented species of medicinal plants to cure various diseases

Table 2 List of some medicinal plant species growing in Dungari mata sacred groves of Jhabua district

Botanical name, voucher specimen no. and family	Local name	Habit	Plant part used	Mode of administration	Uses	Fidelity level	Threat categories
Abrus precatorius L. (Fabaceae)	Ratti	Climber	Leaves	Juice	Mouth ulcer	84	EN
Abrus pulchellus Wallich *ex* Thwaites (Fabaceae)	Kaliratti	Climber	Seeds	Powder	Abortifacient	55	CR
Adhatoda zeylanica Medik. (Acanthaceae)	Adulsa	Shrub	Leaves	Juice	Cough and cold	100	NT
Aegle marmelos (L.) Correa (Rutaceae)	Bel	Tree	Fruit	Juice	Stomach disorder	100	NT
Ammannia baccifera L. (Lythraceae)	Dhan bhaji	Herb	Leaves	Paste	Malaria	55	VUL
Amorphophallus paeoniifolius Araceae (Dennst.) Nicolson (Araceae)	Jangali suran	Herb	Corm	Powder	Joint disease	86	EN
Ampelocissus latifolia (Roxb.) Planch. (Vitaceae)	Panibel	Climber	Roots	Cooked	Vegetable	87	VUL
Anagalis arvensis L. (Primulaceae)	Jonkmari	Herb	Leaves	Infusion	Skin disorder	18	COM
Andrographis paniculata (Burm. *f.*) Wallich *ex* Nees. (Acanthaceae)	Bhuineem	Herb	Leaves	Juice	Malaria	100	EN
Anogeissus latifolia (Roxb. *ex* DC.) Wall. *ex* Guill. & Perr (Combretaceae)	Dhawda	Tree	Gum	Raw	Aphrodisiac	75	NT
Arisaema tortuosum (Wallich) Schott (Araceae)	Jungali Bhutta	Herb	Corm	Poultice	Snakebite	89	CR
Aristolochia indica L. (Aristolochiaceae)	Isharmul	Climber	Roots	Hot infusion	Anthelmintic	100	EN
Asparagus racemosus Willd. (Liliaceae)	Satawar	Climber	Roots	Powder	Galactagogue	100	VUL
Bacopa monnieri (L.) Wettst. (Scrophulariaceae)	Bam	Herb	Leaves	Infusion	Nervous disorder	100	NT
Barleria cristata L. (Acanthaceae)	Tandralu	Herb	Leaves	Tea	Jaundice	85	VUL
Barleria prionitis L. (Acanthaceae)	Katsariya	Herb	Seeds	Instillation	Asthma	55	VUL
Boerhaavia diffusa L. (Nyctaginaceae)	Punarnava	Herb	Roots	Hot infusion	Jaundice	100	NT
Boswellia serrata Roxb. ex Colebr. (Burseraceae)	Salad	Tree	Stem Bark	Decoction	Cardiac disorder	26	NT
Bridelia retusa (L.) Spreng. (Euphorbiaceae)	Agon	Tree	Stem Bark	Juice	Jaundice	20	VUL
Buchanania lanzan Spreng. (Anacardiaceae)	Chirongi	Tree	Seeds	Poultice	Joint disease	65	VUL
Butea superba Roxb (Fabaceae)	Palasbel	Climber	Roots	Decoction	Jaundice	92	EN
Caesalpinia bonduc (L.) Roxb (Caesalpiniaceae)	Ghataran	Climber	Seeds	Hot infusion	Stomach disorder	87	VUL
Calotropis gigantea (L.) R. Br. (Asclepiadaceae)	Aakra	Shrub	Roots	Infusion	Leucorrhoea	91	COM
Canscora decussata (Roxb.) Roem. & Schult. (Gentianaceae)	Sankhaphuli	Herb	Leaves	Juice	Nervine tonic	96	VUL
Cassia absus L. (Mimosaceae)	Ban Puadiya	Herb	Leaves	Infusion	Insecticide	84	OC
Cassine glauca (Rottb.) O. Kuntze (Celastraceae)	Jamrasi	Tree	Fruit	Soup	Leucorrhoea	45	VUL
Cassytha filiformis L. (Lauraceae)	Amarabel	Herb	Whole plant	Hot infusion	Jaundice	88	OC
Celastrus paniculatus willd (Celastraceae)	Malkangani	Climber	Seeds	Poultice	Joint disease	59	EN
Ceropegia bulbosa Roxb. (Asclepiadaceae)	Ghilonta	Climber	Bulb	Soup	Urinary disorder	82	CR
Chlorophytum borivilianum Santapau & Fernandis (Liliaceae)	Dhawali musli	Herb	Roots	Instillation	Debility	64	CR
Cissampelos pareira. var. *hirsuta* (Buch.-Ham. ex DC.) (Menispermaceae)	Bhanjwel	Climber	Leaves	Juice	Anthelmintic	81	NT
Corallocarpus epigaeus (Rottl. & Willd.) Hook. *f.* (Cucurbitaceae)	Marchikando	Climber	Roots	Powder	Diabetes	71	EN

Table 2 continued

Botanical name, voucher specimen no. and family	Local name	Habit	Plant part used	Mode of administration	Uses	Fidelity level	Threat categories
Costus speciosus (J. Koeing) Sm. (Costaceae)	Jangali Aadu	Herb	Rhizome	Poultice	Headache	53	EN
Cryptolepis buchanani Roem. & Schult. (Asclepiadaceae)	Dudhibel	Climber	Latex	Latex	Snakebite	91	NT
Curculigo orchioides Gaertn. (Hypoxydaceae)	Kali musli	Herb	Roots	Paste	Wound and cuts	92	VUL
Curcuma pseudomontana J. Graham (Zingiberaceae)	Jangli haldi	Herb	Rhizome	Hot infusion	Pneumonia	93	EN
Dioscorea hispida Dennst. (Dioscoreaceae)	Kanda	Climber	Bulb	Soup	Debility	98	EN
Dioscorea pentaphylla L. (Dioscoreaceae)	Dukar kanda	Climber	Bulb	Hot infusion	Piles	92	CR
Diospyrus melanoxylon Roxb. (Ebenaceae)	Tembru	Tree	Fruit	Raw	Diarrhoea	100	NT
Enicostema axillare (Lam.) A. Raynal (Gentiaceae)	Ded paliya	Herb	Leaves	Juice	Malaria	98	NT
Ensete superbum (Roxb.) Cheesman (Musaceae)	Choti keli	Herb	Roots	Paste	Bone fracture	69	CR
Euphorbia fusiformis Buch.- Ham. (Euphorbiaceae)	Kharkhundiya	Herb	Roots	Poultice	Joint disease	98	NT
Gardenia latifolia Ait. (Rubiaceae)	Papda	Tree	Stem bark	Decoction	Piles	62	NT
Grewia flavescens Juss. (Tiliaceae)	Dhamni	Shrub	Fruit	Raw	Debility	69	NT
Gymnema hirsutum Wight & Arnott in Wight (Asclepiadaceae)	Meshringi	Climber	Leaves	Powder	Diabetes	98	CR
Habenaria commelinifolia (Roxb.) Wallich *ex* Lindl. Orchidaceae	Jangali aalu	Herb	Bulb	Cooked	Vegetable	95	EN
Habenaria digitata Lindl. (Orchidaceae)	Ranaalu	Herb	Bulb	Paste	Wound and cuts	62	VUL
Habenaria frucifera Lindl. (Orchidaceae)	Jangali aalu	Herb	Bulb	Hot infusion	Leucorrhoea	89	CR
Habenaria marginata Colebr. (Orchidaceae)	Jangali aalu	Herb	Bulb	Decoction	Jaundice	84	EN
Helicteres isora L. (Sterculiaceae)	Atodi	Shrub	Fruit	Raw	Stomach disorder	96	VUL
Helitropium indicum L. (Boraginaceae)	Hathisunda	Herb	Leaves	Instillation	Malaria	45	OC
Hemidesmus indicus (L.) R. Br. (Asclepiadaceae)	Anantmul	Climber	Roots	Infusion	Blood purifier	95	NT
Icnocarpus frutescens (L.) R.Br. (Apocynaceae)	Kali Dudhi	Climber	Latex	Latex	Respiratory disorder	64	NT
Impatiens balsamina L. (Balsaminaceae)	Guldawdi	Herb	Flower	Tea	Jaundice	54	OC
Leea asiatica (L.) Ridsdale (Leeaceae)	Nanli Danhi	Herb	Bulb	Paste	Joint disease	85	VUL
Leea macrophylla Roxb. *ex* Hornem. (Leeaceae)	Motali Danhi	Herb	Bulb	Poultice	Skin disorder	68	EN
Leonotis nepetifolia (L.) R. Br. (Lamiaceae)	Gathora	Herb	Seeds	Infusion	Urinary disorder	89	COS
Mitreola petiolata (J.F. Gmelin) Torr & A. Gray (Loganiaceae)		Herb	Leaves	Juice	Urinary disorder	28	NT
Mucuna pruriens (L.) DC. (Fabaceae)	Kewach	Climber	Seeds	Raw	Sexual disorder	91	VUL
Musa rosacea Jacq. (Musaceae)	Jangali kela	Herb	Fruit	Poultice	Constipation	84	EN
Physalis minima L. (Solanaceae)	Poptiya	Herb	Fruit	Juice	Leucorrhoea	58	COM
Pittosporum wightii A.K. Mukherjee (Pittosporaceae)	Yekadi	Tree	Fruit	Decoction	Sexual disorder	26	NT
Plumbago zeylanica L. (Plumbaginaceae)	Chitrak	Shrub	Roots	Paste	Skin disorder	68	NT
Pterocarpus marsupium Roxb. (Fabaceae)	Bijasal	Tree	Stem bark	Infusion	Diabetes	98	NT

Table 2 continued

Botanical name, voucher specimen no. and family	Local name	Habit	Plant part used	Mode of administration	Uses	Fidelity level	Threat categories
Pueraria tuberosa (Roxb. *ex* Willd.) DC. (Fabaceae)	Sirbala	Climber	Bulb	Poultice	Joint disease	100	EN
Remusatia vivipara (Roxb.) Schott (Araceae)		Herb	Leaves	Hot infusion	Asthma	61	VUL
Rhus parviflora Roxb. *ex* DC (Anacardiaceae)	Tung	Tree	Fruit	Raw	Laxative	25	NT
Sauromatum venosum (Aiton) Schott (Araceae)	Pebada	Herb	Corm	Hot infusion	Anthelmintic	88	EN
Schleichera oleosa (Lour.) Oken. (Sapindaceae)	Kusum	Tree	Seeds	Oil	Joint disease	81	VUL
Schrebera swietenioides Roxb. (Oleaceae)	Mokha	Tree	Fruit	Instillation	Eye diseases	66	NT
Solanum virginanum L. (Solanaceae)	Bhatkataiyya	Herb	Seeds	Paste	Toothache	62	OC
Soymida febrifuga (Roxb.) A. Juss. (Meliaceae)	Rohani	Tree	Stem bark	Decoction	Blood purifier	84	VUL
Spermacoce hispida L. (Rubiaceae)		Herb	Roots	Infusion	Malaria	89	COM
Sphaeranthus indicus L. (Asteraceae)	Gorakhmundi	Herb	Inflorescence	Hot infusion	Snakebite	58	NT
Spigelia anthelmia L. (Loganiaceae)	Gudari	Herb	Leaves	Juice	Anthelmintic	98	OC
Spilanthes calva DC. (Asteraceae)	Akalkara	Herb	Inflorescence	Paste	Toothache	100	NT
Spondias pinnata (L. *f.*) Kurz (Anacardiaceae)	Khatamba	Tree	Fruit	Cooked	Vegetable	98	NT
Sterculia urens Roxb. (Sterculiaceae)	Kullu	Tree	Gum	Raw	Typhoid fever	89	VUL
Syzigium heyneanum Wall. ex Wight & Arn. (Myrtaceae)	Jangali jamun	Tree	Stem Bark	Infusion	Diabetes	88	NT
Tinispora cordifolia (Willd.) Miers ex Hook.*f.* & Thoms. (Meliaceae)	Giloy	Climber	Stem bark	Instillation	Blood purifier	82	NT
Trichosanthes cucumerina L. (Cucurbitaceae)	Jangali chichinda	Climber	Fruit	Fuming	Respiratory disorder	32	VUL
Tylophora rotundifolia Buch.-Ham. *ex* Wight (Asclepiadaceae)	Dambel	Herb	Leaves	Juice	Kidney disorder	58	EN
Uraria picta (Jacq.) Desv. (Fabaceae)	Dabra	Herb	Inflorescence	Tea	Respiratory disorder	82	EN
Urena lobata L. (Malvaceae)	Bachita	Herb	Fruit	Decoction	Sexual disorder	28	OC
Urginea indica (Roxb.) Kunth (Liliaceae)	Jangli Kando	Herb	Bulb	Powder	Typhoid fever	41	EN
Vanda tessellata (Roxb.) Hook. Ex G. Don (Orchidaceae)	Vainda	Epiphyte	Leaves	Paste	Scorpion bite	85	VUL
Vigna sublobata (Roxb.) Babu & Sharma (Fabaceae)	Jangali mung	Herb	Leaves	Soup	Leucorrhoea	35	NT
Vitex negundo L. (Verbinaceae)	Sehni	Shrub	Roots	Infusion	Cough and cold	88	NT
Withania somnifera (L.) Dunal (Solanaceae)	Asgand	Shrub	Leaves	Powder	Debility	100	VUL
Woodfordia fruticosa (L.) Kurz (Lythraceae)	Dhawai	Shrub	Flower	Tea	Blood purifier	91	NT

CR critically endangered, *EN* endangered, *VUL* vulnerable, *NT* near threatened, *COM* common, *OC* occasional, *COS* cosmopolitan

(Table 2). Leaves (90 sps.) were the most frequently used plant part for the preparation of medicine (Fig. 7). The routes of administration was mostly infusion (36 sps.), decoction and paste (31 sps. Each) prepared from freshly collected plant material just before use (Fig. 8). Medicine preparations made from different parts of medicinal plants were used for treatment of various diseases; species were used for curing 43 types of disorders (Fig. 9). Among

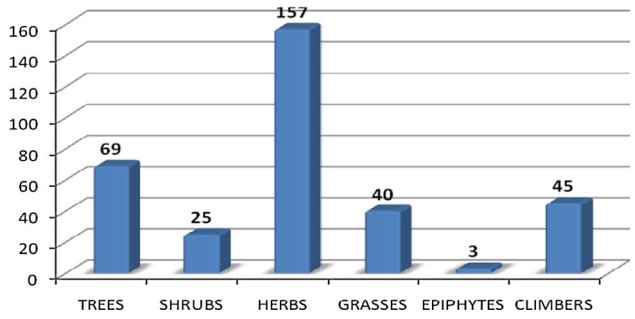

Fig. 4 Life forms reported in Dungari mata sacred grove

them, joint diseases and skin disorders represent highest number of plant species, i.e. (22 sps.), while eye diseases, earache, bone fracture represent lowest number of plants species, i.e. (2 sps. each). Antidotes for scorpion sting and snakebite were prepared using herbal formulations developed by the tribal people from the sacred grove. Effectiveness of the herbal drug was connected to the nature of the disease and dose response. Doses were mainly taken twice a day because people are present at home on the morning and evening. Doses are differing from patient to patient and same patient from time to time based on the cause and effectiveness of the drug. The majority of the remedies were prepared from freshly collected plant material from the wild conditions and mostly from a single species, or sometimes they mixed with other plant materials. When fresh plant parts are not available, dried parts are also used. Medicinal plants cited by informants (aged above 50 years) showed that elder men and illiterate people

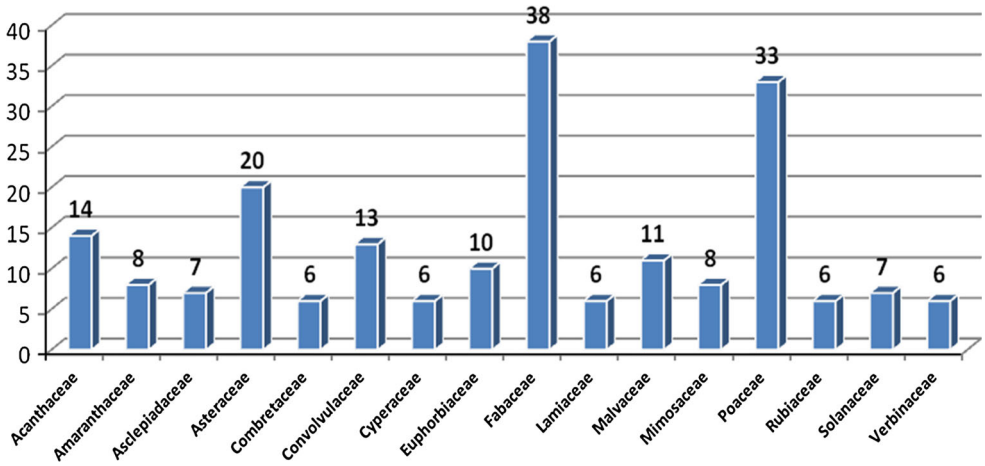

Fig. 5 Dominant families reported in Dungari mata sacred grove

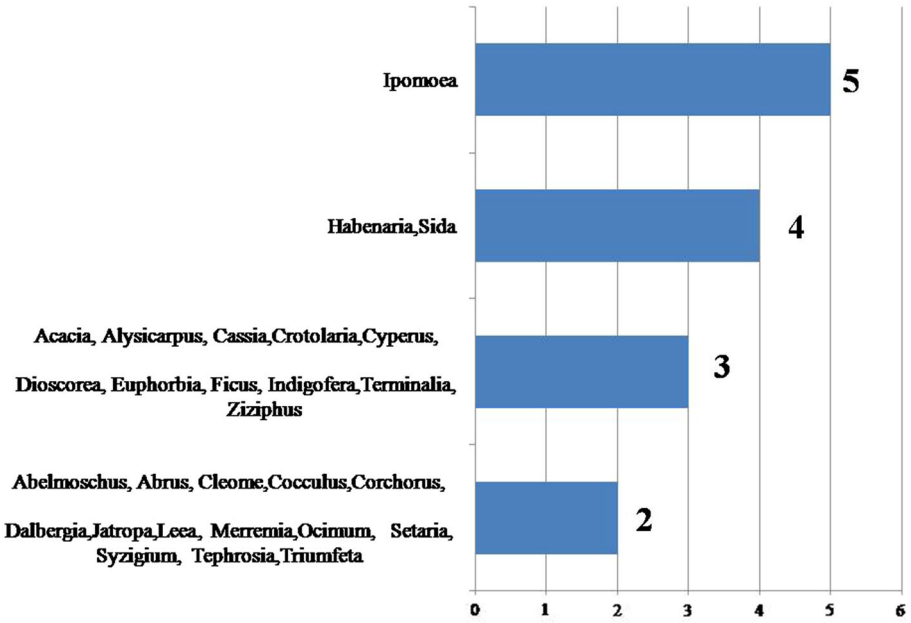

Fig. 6 Dominant genera reported in Dungari mata sacred grove

Table 3 Category of various ailments and their informant consensus factor (ICF)

Category (diseases/disorders)	Plant species	Used reports	Informants consensus factor (ICF)
Abortifacient	3	12	0.81
Anthelmintic	6	20	0.73
Asthma	8	24	0.69
Blood purifier	5	8	0.42
Bone fracture	2	10	0.88
Cardiac disorder	3	8	0.71
Constipation	5	9	0.5
Cough and cold	6	12	0.54
Debility	4	7	0.5
Diabetes	5	110	0.96
Diarrhoea	5	18	0.76
Earache	2	9	0.87
Eye disease	2	51	0.98
Gonorrhoea	4	12	0.72
Hairtonic	3	8	0.71
Headache	5	61	0.93
Insectiside	4	9	0.62
Jaundice	19	28	0.33
Joint disorder	22	41	0.47
Kidney disorder	8	21	0.65
Leucorrhoea	16	21	0.25
Malaria	9	36	0.77
Nervous disorder	5	22	0.80
Piles	5	8	0.42
Pneumonia	4	18	0.82
Respiratory disorder	14	25	0.45
Scorpion bite	7	21	0.7
Sexual disorder	10	32	0.70
Skin disorder	22	49	0.56
Snakebite	11	22	0.52
Stomach disorder	12	98	0.88
Toothache	8	15	0.5
Typhoid	10	18	0.47
Urinary disorder	10	21	0.55
Wound and cuts	6	21	0.75

have better medicinal plant knowledge compared to younger generations, literate and females. These observations correlate well with studies conducted elsewhere (Sharma et al. 1992; Gedif and Hahn 2003; Muthu and Ignacimuthu 2005; Upadhyay et al. 2007; Panghal et al. 2010). The survey indicates that the study area has plenty of medicinal plants to treat a wide spectrum of human ailments.

3.6 Threat to the biodiversity

The present status of the grove is of concern, as it is gradually declining under constant anthropogenic pressure. Spiritual sentiments of the people are attached with the erected stones (stones of brotherhood), but not with the plant diversity of the area. The tribal community specially the younger generation showed belief on the deities; they are not interested in the resources present in the grove. This exposes the biodiversity for exploitation. In the present study, 81 species of various threat categories i.e. critically endangered 8 sps., endangered 20 sps., vulnerable 24 sps. and near threatened 29 sps. have been recorded from a grove (Fig. 10). As per the information of local elderly people, these species were predominantly growing in the past in the surrounding areas but vanished due to various reasons such as over exploitation, shifting cultivation and

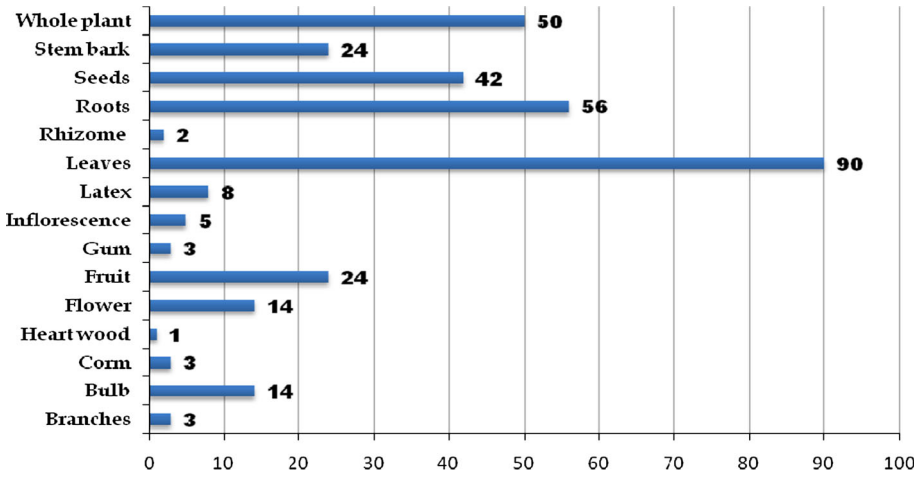

Fig. 7 Parts used for curing various diseases

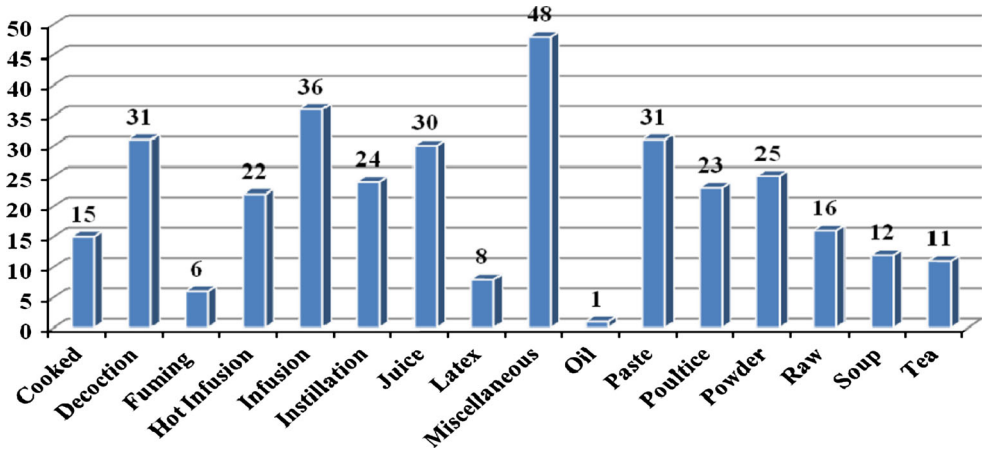

Fig. 8 Forms of medication used in herbal healthcare system

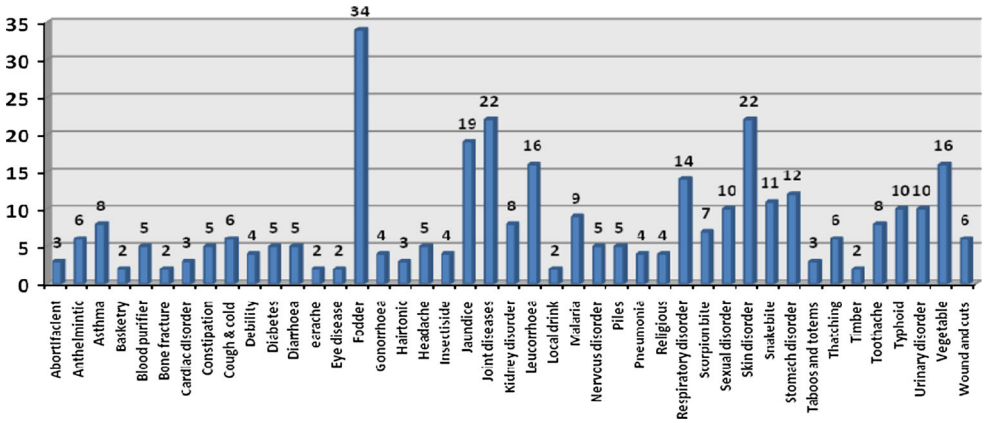

Fig. 9 Number of species used as ethnobotanicals in Dungari mata sacred grove

other socioeconomic activities. Therefore, there is urgent need for conservation and protection of sacred groves before it completely disappears from this region. There is a delicate relationship between the biodiversity, tradition and culture of the tribal communities. Disruption of biodiversity by any means results in the degeneration of sacred groves and also traditional rural people and their culture.

4 Conclusions

Man's belief in supernatural forces can be traced back to time immemorial. Behind each belief, we can find stories connecting it with purpose of pleasing some one or the fear of some thing. The present work revealed that sacred groves act as a gene pool or preservation plot and harbours

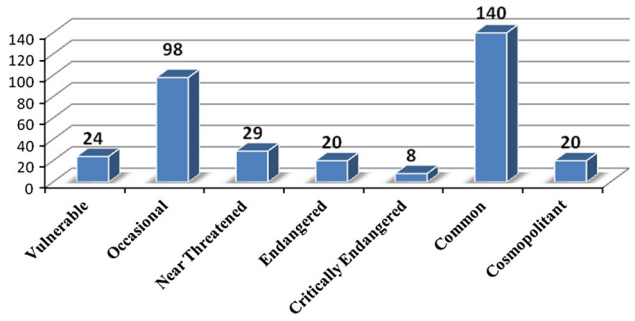

Fig. 10 Number of species in various threat categories

rare, endemic, endangered and economically and ethnomedicinally very important plants because of the restraints exercised due to the fear of deities/spirits residing in the grove.

Various cultural and religious rituals and celebrations are performed in the groves, and except for the medicinal purpose, none of the plant species are harmed by human beings. Undoubtedly, the sacred groves are a refuge for rarity and endemism of several plant species and can be termed as a treasure house of threatened species, dispensary of medicinal plants and gene bank for economically important species (Vartak et al. 1986; Godbole 1996; Khan et al. 1997; Tiwari et al. 1998a, b, Jeeva et al. 2005, 2006). In the present study, the majority of species in the sacred grove were used medicinally towards the health care of indigenous rural people settled in the vicinity. The observations of the present study showed that traditional medicine plays a significant role among the tribal people. The study paves the way for further confirmation of doses; pharmacological and phytochemical screenings of these medicinal plants need to be taken up to find out the exact phytochemicals that help in curing the diseases. It is evident from the interviews conducted from the tribal people in the study site that knowledge of medicinal plants is limited to traditional healers and elderly persons who are living in rural areas.

People's rural appraisal study revealed that different non-timber forest produces (NTFPs) are being collected often by the local people. Due to the fast-changing society framework and mindset of the younger generation, the spiritual concept behind the grove has been diluted. The PRA study inferred that about 15 % of the area was encroached upon by cultivation and about 10 % of the forest cover degraded due to clearing of large fallen trees for house construction as well as for fuel. It is clear that this sacred grove cannot be preserved based only on spiritual belief. There is an urgent need to implement rural participatory management practices by the state government, with the help of the existing village community and forest committees. The area adjacent to the grove may be developed as a supply reserve forest, which can supply the biomass need of the people. In turn, it also would reduce anthropogenic pressure on the sacred grove. This present study also reveals that if proper conservational measures are not introduced in the near future, there may be a great loss of existing plant diversity. Thus, there is ample scope for further research on plant diversity, community attributes and natural regeneration.

Conservation of such sacred groves is crucial not only for their sources of medicinal plants but also for meeting the basic herbal needs for the local people. The degraded sacred groves should be immediately restored or regenerated using appropriate biotechnological tools and by raising awareness among the tribal people regarding the importance and conservation of such sacred groves.

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