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Bio-profiling of Sacred Groves Jodhpur District, Thar Desert of Rajasthan, India: A case study

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Keywords

Sacred Groves;
Biodiversity;
Thar Desert;
Avifauna;
Richness

Abstract

The importance of sacred groves as biodiversity refuges, agents of soil and water, sources of genetic resources set its examples of sustainable human-nature coexistence shaped by centuries-old cultural practices. Acting as natural sanctuaries where hunting, cutting and grazing are traditionally prohibited, thus allowing native biodiversity to thrive and offering opportunities for in situ conservation of medicinally economically valuable plants. The orans of Rajasthan has depositary of medicinal richness and ecological functionality hence sustaining human health and environmental balance in a fragile ecosystem. Seven orans in and around Jodhpur district of Rajasthan, India were assessed for its historical values, floral and faunal biodiversity showed a rich number of floral wealth with respect to their medicinal values. The rich avifaunal biodiversity included a sum of 121 bird species in theses orans and the adjoining areas from all seven oran sites

1. Introduction

Sacred Groves are considered as “Sacred Natural Sites” (IUCN) (Oviedo *et al.,* 2005). These are the relic forest patches preserved in the name of religion and culture over the years through the civilization. Their history of origin is not found in any documents, but pass from one generation to other through oral history and worshiping practices. They extend from Asia, Africa, and Europe to America mostly in Africa and Asia. In India, scared groves are present from North-east Himalayan region, Western and Eastern Ghats, Coastal region, Central Indian Plateau and Western desert (Malhotra *et al.,* 2001). Indian sacred groves probably have pre-Vedic origin. They are associated with indigenous native/tribal communities who believe in divinity of nature and natural resources. The present thrust is on ecosystem functioning, ecological services and biodiversity conservation importance (Chandrashekara and Ramakrishnan, 1994), a significant emphasis highlighted after The Convention of Biodiversity, 2002. There are more than a lakh such sacred groves in the country, have different names in different states, such as Devrai, Devban, Devbhumi, Gumpa etc. In Rajasthan, they are called Oran which is derived from the Sanskrit word *aranya*, meaning forest. They are patches of jungle preserved in the name of local deities or saints.

As we move from north to south or east to west, signature of peaceful coexistence of humans with biodiversity is observed in the form of Orans or sacred groves. Our traditional cultural values have shown tolerance towards the nature, following which we have also developed a conscious, hence the conservation of these sites to protect the biodiversity for traditions, religious purposes, and ecological value and to maintain sustainability. The irony of sacred groves is that biodiversity conservation focus mainly on protected areas, ignoring their direct benefits in cultural preservation. The oldest form of biodiversity conservation practices are the traditions, which the local communities thriving here, practice in their daily life. The Honourable Supreme Court of India, in their historical and monumental decision, in December 2024, directed the Rajasthan Government to identify and mapping and notification of sacred groves as Deemed Forest. The court has further recommended to prepare a nationwide policy to identify and protect the orans across the country. The decision comes to emphasise the ecological and cultural significance of our prestigious heritage sites which are also have a potential carbon repository since time immortal.

2. Materials and Methods

A detailed literature search, public discussion and dialogue was initiated to identify the Orans in published literature. This revealed that there are various Orans of different sized and scattered in distribution across western Rajasthan. To begin with from Jodhpur district, seven prominently refereed Oran sites were selected for the study. A yearlong survey was conducted in 2014-2015 with the help of many local volunteers and field biologists. These Oran landscapes are located at Kolu Pabiji (Lohawat), Bhavad (Baori), Umaid Nagar (Tiwanri), Kharda-Mewasa (Tinwari), Bapini (Osian), Jakhan (Osian) and Shetrava (Shergarh). These all Orans are situated in the vast area of northern side of Jodhpur district and harbours many rare, endangered and threatened species of plants and animals.

2.1. Study sites: This study was conducted in seven most revered and well known Orans of Jodhpur district, to document the biodiversity values and diversity along with the history (Fig. 1).

2.1.1. Kolu Pabuji's Oran (Lohawat Block): The oran of Kolu Pabuji is located in Lohawat Block, Jodhpur district and extends between 26° 53' N to 26° 57' N latitude and 72° 15' E to 72° 19' E longitude. It is situated 25 km west of Phalodi town and 145 km north to the district head quarter. It is of around 29 km^2 enriched with rich natural vegetation and wildlife. The oran is equally divided into two unequal parts by the Mega Highway (from Shergarh to Phalodi).

2.1.2. Bhawad Oran: The village Bhawad is situated near Jodhpur city, and having two different orans. The large one is known as Ujalia Mataji's Oran and smaller one is known as Kanwar Gopalji's Oran. The former Oran is situated between Bhawad and Ujalia village, Bawari Block which extends between 26° 33' N to 26° 27' N latitude and 73° 04' E to 73° 01' E longitude. It is located 36 km North of Jodhpur city and 20 km west of Bawari block head office and well connected by road. The Bhawad-Ujalia village road intersects the entire Oran in almost equal halves. The Oran is roughly 19 km^2 whereas the Kanwar Gopalji Oran is small with an area of around 2 km^2 and situated on Bhawad-Umed Nagar road.

2.1.3. Umaid Nagar Orans: The village Umed Nagar is situated near Jodhpur city, and having two different orans. The large one is known as Hanumanji's Oran and smaller one is known as

Ramdeoji's Oran. The Hanumanji's Oran is situated in between Umed Nagar and Jurr village, Tiwari Block of Jodhpur, which lies between 26° 34' N to 26° 33' N latitude and 73° 01' E to 73° 02' E longitude. The Ramdeoji's Oran is also around 26° 34' N to 73° 01' E in location. It is located 44 km North of Jodhpur city and well connected by road. The Jodhpur-Mathania road passes from the east of Ramdeoji's and West of Hanumaji's Oran. The area of Hanumanji's Oran is roughly 59 hectare and Ramdeoji's Oran is roughly 23 hectare in size and is in very highly degraded state of vegetation and wildlife point of view. The possible reason could be its small size and close proximity to the Umed Nagar village settlement as well as gravelly plain and loamy soil support less vegetation.

2.1.4. Kharda-Mewasa Orans: The Kharda-Mewasa village lies in Osian Tehsil of Jodhpur district. It occupies large pasture land and small Oran, whereas a large hilly wasteland is under forest jurisdiction. All these landscapes are together forming a good biodiversity refuse site. These are known as Ramdeoji Ka Oran, Kharda pasture land and Mewasa hillocks around temple. The Ramdeoji's Oran and pasture land is situated in north-east of Kharda village of Tiwari Block of Jodhpur district extends between 26° 37' N to 26° 39' N latitude and 73° 01' E to 73° 02' E longitude. The Mewasa forest block situated around 26° 39' N to 26° 43' and 73° 02' to 73° 05' E in location. The area of Ramdeoji's Oran is roughly 53 hectare and pasture land is of roughly 203 hectare in size and support good quality of vegetation and associated wildlife. The Mewasa block is roughly five times of the pasture land and completely undulating hilly terrain with many gullies and dry stream beds.

2.1.5. Bapini Orans: The Bapini village is located in Osian Tehsil of Jodhpur district in Rajasthan, India. It is situated 104 km away from district headquarter Jodhpur and 43 km from Osian block. It is having large Oran and village is almost surrounded by Oran from all sides. The landscapes are more or less plain and supports good biodiversity refuse site. The Oran is known as Mehoji's Oran and having a deity temple close to village. The Mehoji's Oran is situated in Bapini village of Osian Block of Jodhpur district and extends between 26° 57' N to 27° 01' N latitude and 72° 56' E to 73° 00' E longitude. The village Bapini is situated almost in the western side of the Oran. The area of Oran is roughly 53 hectare and pasture land is of roughly 17 km^2 in size and support good quality of arid vegetation and dependent animal life.

2.1.6. Jogmaya ji's Oran, Jakhan Village: The Jakhan village is located in Osian Tehsil of Jodhpur district in Rajasthan. It is located 110 KM towards north from district headquarter Jodhpur, 38 km from Osian city. It is having large Oran and village is almost surrounded by Oran from all sides. The landscape is more or less plain, with high shifting sand dunes in the north-western side of Jakhan village. The area supports good biodiversity refuse site. The Oran is known as Jogmaya ji's Oran and having a deity temple close to village. It extends between 27° 00' N to 27° 02' N latitude and 73° 04' E to 73° 06' E longitude. The area of Oran is roughly 6.5 km^2 in size and support good quality of arid vegetation and dependent animal life.

2.1.7. Jogmaya ji's Oran, Setrawa Village: The Setrawa village is located in Shergarh Tehsil of Jodhpur district in Rajasthan. It is located 109 km towards north-west of district headquarter Jodhpur, on Dechu-Jodhpur Road. It is having large Oran and village is almost surrounded by Oran from all sides. The landscape is more or less sandy plain with high shifting sand dunes in the north and east side of Setrawa village. The area supports good biodiversity refuse site. The Oran is

known as Jogmaya ji's Oran and having a deity temple in the eastern side of the Oran. It extends between 26° 35' N to 26° 36' N latitude and 72° 18' longitude. The village Setrawa is situated almost in the western side of the Oran. The area of Oran is roughly 14 km^2 in size and support good quality of arid vegetation and dependent animal life.

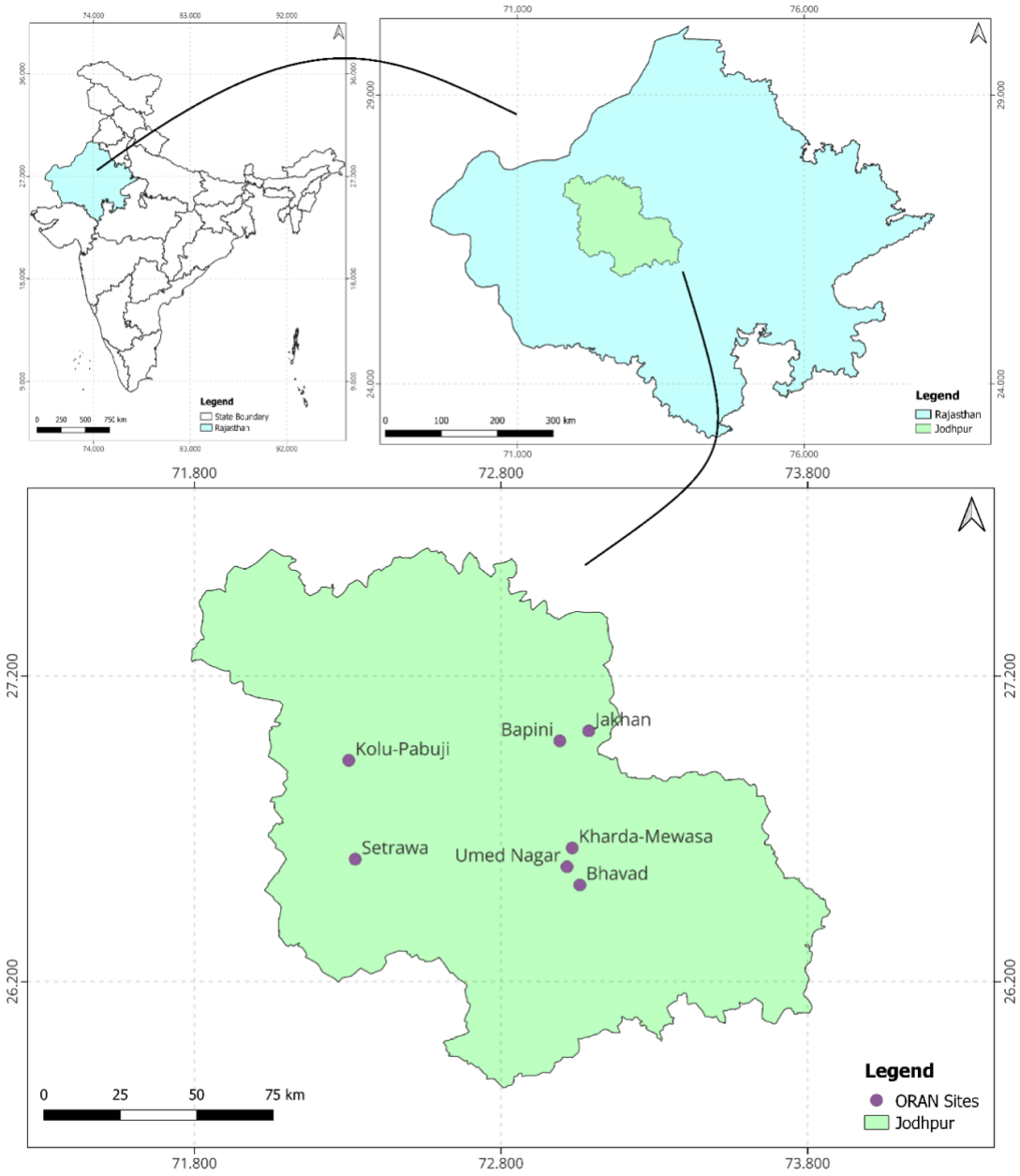

Fig. 1. Location of seven prominent Oran or Sacred Grove sites of Jodhpur District, Rajasthan.

2.2. Geology, soil, climate and rainfall

The dominant landform of the Kolu pabuji Oran is an old gravelly plain and the soil characteristic is almost all type of soil, including sandy, loamy and gravelly. The soil was similar

in all the orans. The geology of Bhawad Oran displays longitudinal sandstone hillock, forming small catchment for seasonal nallahs and rich alluvial soil intermittently with gravelly plain; the terrain of the entire Bhawad Oran is very much undulating. The central part is occupied by old sandstone hillock and forming a catchment for seasonal nallahs in all directions. These nallahs joins together in downstream and joins Jojari River. The climate of Ujalia Mataji Oran (part of Bhawad oran) is as usual hot and arid, alike the climatic conditions of western Rajasthan. The average mean rainfall is around 370 mm which fluctuates greatly.

The landform of both the Orans of Umaid has loamy/alluvial soil intermittently with gravelly plain. The terrain of the entire Oran is very flat, and slightly raised northern side. This slope makes a catchment for water pond in Hanumanji's Oran. The average rainfall is around 360 mm. Dominant landform of the pasture and Orans of Kharda-Mewasa is a sandy plain with loamy/alluvial soil intermittently with gravels. Whereas the Mewasa block is completely under hilly terrain and deep valleys. The terrain of the entire oran and pasture is very flat, and slightly raised northern side. This slope makes a catchment for water pond in Ramdeoji's Oran. Alike other orans, the dominant landform of the Bapini Oran is also sandy plain and loamy/alluvial soil intermittently with gravels. The western side of Oran is having large size sand barren dunes. The terrain of the entire oran is very flat, whereas the western side the having high sand dunes. These gentle slopes make a catchment for water pond in Mehoji's Oran. Dominant landform of the Jogmaya ji ka Oran, Jhakan village is similar to earlier ones. The western side of oran is having large size sand barren dunes. The terrain of the entire oran is very flat, whereas the western side the having high sand dunes. These gentle slopes make a catchment for water pond in Jogmaya ji's Oran. And, finally, the dominant landform of the Jogmaya ji ka Oran of Shetrawa, is a sandy plain and loamy/alluvial soil intermittently with gravels. The landscape Oran is largely covered by shifting sand dunes. The terrain of the entire Oran is very undulating and has high sand dunes. These gentle slopes make a catchment for water pond in Jogmaya ji's Oran.

2.3. Sampling procedure

For the plant identification (Tree, shrub and grass), reference book by Hajra *et al.* (1996) was used. For spider identification, handbook of Tikader (1987) was used as reference as well as technical help from experts of Zoological Survey was also sought. The reference guide by Whitaker and Roman (2008) was used for snake identification. For identification of beetles, resource person of Zoological Survey of India helped out by identifying the clicked pictures of the beetles from the orans. Identification of birds were carried out by standard reference guides (Grimmett, *et al.,* 2011, Ali and Ripley, 2007 and Grewal, 2016).

3. Results and Discussion

3.1. Historical Importance

3.1.1. Kolu Pabuji's Oran (Lohawat Block): Kolu Pabuji oran is located around the local deity Pabuji, who is very famous folk-deity of Rajasthan and was born in a house of Dhadal Rathore in Kolu village during 14th century. He was a mediaeval Rajput prince but in present days worshipped by Rabari herdsmen and others mainly throughout the Rajasthan, followed by Gujarat, Madhya Pradesh respectively. Kolu Pabuji temple is served by priests of Nayak community, whereas Bhopa community of Rajasthan are the priest singers of Pabuji. They represent the life story on

canvas, called *Phad* and perform in front of the public through religious songs. The *Phad* is of around 30 feet long sheet on which miniature scenes depicting the life of Pabuji is either painted or sewn. The area adjacent to temple is considered a scared land since 14th century, when Pabuji started preaching locals and also diagnosed the ailments of their livestock by his divine power. The oran is the area, where he worked and organized public courts and addressed gatherings. The oran is mainly a flat plain with few small sand dunes in west and south directions. The terrain of Oran village is a smooth slope to the east side with six seasonal water bodies to store rainwater from the catchment of the Oran, hence providing an alternate source of water for the fauna.

3.1.2. Bhawad Oran: As mentioned earlier, Bhawad oran of village Bhawad is occupies two orans, namely, Ujalia Mataji's Oran and smaller the Kanwar Gopalji's Oran. The Ujalia Mataji's Oran is very old and having a shrine of Jogmaya Goddess. As per the local's narration, statues of Jogmaya devi automatically appeared in a natural cave in the gorge of sand stone hills and people started worshipping then. This is a very old shrine and nobody knows its origin. The area surrounding the temple and adjacent hillocks are in the designated Oran boundary in revenue record. This area is covered by medium height hillocks, sandy and flat plain and has sand dunes at the west and south directions.

3.1.3. Umaid Nagar Orans: The village Umed Nagar is situated near Jodhpur city, and having two different orans. The large one is known as Hanumanji Ka Oran and smaller one is known as Ramdeoji's Oran. The ***Hanumanji's Oran*** possesses a very old Hanuman Temple along with a perennial water body. As per the saying of locals, this water pond never dries and villagers use its water for drinking purpose. The faith of this temple is to this extend that the local courts is held at the courtyard of the temple and hearings, decisions and confessions are taken in front of Hanuman ji's statue. Thus, the settlement last longer and both the parties live in harmonious way. The temple is situated on a small elevated mound and northern side of temple is a very deep and has perennial water pond. The water of this pond, as per belief, has many medicinal and divine properties. It is a very old shrine and nobody knows its origin. The area surrounding the temple and adjacent open vast plains are in the designated Oran boundary in revenue record. The ***Ramdeoji's Oran*** is also having a small temple of local deity Ramdeo ji, and surrounding area is declared as Oran. This area was small in comparison with Hanumanji's Oran.

3.1.4. Kharda-Mewasa Orans: The village, Kharda Mewasa of Osian Tehsil of Jodhpur district occupies large pasture land and small Oran, whereas a large hilly wasteland is under forest jurisdiction. These are known as Ramdeoji Ka Oran, Kharda Pasture and Mewasa hillocks around temple. The Ramdeoji's Oran of Kharda-Mewasa is having a very old Ramdeoji Temple and a perennial water body adjoining to village. The Mewasa temple and adjoining water body, as per the locals narrative, the value and respect of this temple is so much that various skin diseases and ailments get cured after bathing in the water of this temple pond. The Mewasa temple is situated close to a narrow gauge of a valley. A dam was constructed during erstwhile state's time with the financial help from rulers of Marwar state and this formed a perennial water body in the northern side of temple. The water of this pond, as per belief, has many medicinal and divine properties. It is a very old shrine. The area surrounding the temple and adjacent open vast plains are under the jurisdiction of forest department and support many rare animals. The Kharda village lies between the Ramdeoji's Oran and pasture land. It is a vast gravelly and sandy plain landscape covered by small sand dunes and flat agriculture fields. The village settlement is in the south of oran and on

Kharda to Osian road. The Mewasa temple is located in the middle of the vast scrub and hilly area and having few deep valleys.

3.1.5. Bapini Orans (Bapini Kalan and Bapini): The Bapini village of Osian Tehsil is situated 104 km away from Jodhpur district. It is having large oran and village is almost surrounded by oran from all sides. The landscapes are more or less plain. The oran is known as Mehoji's Oran and having a temple close to village. The Mehoji's Oran of Bapini village is having a very old temple of local deity Mehoji and 2-3 perennial water body adjoining to village. The entire oran has been dedicated to the temple deity and protected by villagers with great zeal and reverence since many centuries back. The Mehoji's temple is located in the middle of the vast arid scrub land and close to Bapini village.

3.1.6. Jogmaya ji's Oran, Jakhan Village: The oran of Jogmaya ji of Jakhan village possess very old religious site and temple of local deity Goddess Jogmaya and 3 perennial water bodies adjoining to village. The entire oran has been dedicated to the temple deity and protected by villagers with great zeal and reverence since many centuries back. The Jogmaya ji's temple is located in the western side of oran and village is situated in the south of the oran.

3.1.7. Jogmaya ji's Oran, Setrawa Village: The Jogmaya ji's Oran of Setrawa village is having a very old religious site and temple of local deity Goddess Jogmaya and 2 perennial water bodies adjoining to village. The entire oran has been dedicated to the temple deity and protected by villagers with great zeal and reverence since many centuries back. The Jogmaya ji's temple is located in the western side of oran, close to Jodhpur-Dechu road and village is situated in the east of the oran.

3.2. Biodiversity Profile of Orans

The orans studied in the paper were observed with a richness of biodiversity. Just like other orans, worldwide, the killing is prohibited in these orans too, which might be the sole reason for such biodiversity. Economically important plants and all wildlife were recorded during the study and entire checklist has been attached as annexure.

3.3. Important Floral Wealth of Oran

The Kolu Pabuji Oran and rest orans falls under Desert Bio-geographic zone (3A) (Rodgers *et al.,* 2002). This is directly reflecting in the type of vegetation available in the entire area, which is having affinity to desert as well as semi-arid type of vegetation classification. The vegetation is xerophytic, characterized by thorny and sparse trees. Floral wealth of the area includes, Khejari (*Prosopis cineraria*), which is the State tree of Rajasthan and this is the most dominant tree in all of these oran sites. This species is also symbol of survival in the harsh environment of the arid region, plays a pivotal role in the rural economy. Followed by other trees like, Kair (*Capparis decidua*), Kumtha (*Acacia senegal*) and Peelu or Jaal (*Salvadora persica* and *Salvadora oleoides*). The state flower, Rohida (*Tecomella undulata*) is also called Desert Teak, and symbol of beauty and resilience. Recently it has been listed as endangered category, by IUCN. The vegetation of the major part of the region can be described as thorn forest type (Champion and Seth, 1968). It consists mainly of small thorns or prickly shrubs, sparsely located along with few scattered trees.

The perennial and drought- resistant herbaceous plants are limited in species richness. The landscape in the winters appear barren as the ephemerals appear during monsoon, finish their life cycle before onset of winters, leaving few perennial bushes along with trees. The dominant shrubs such as Jhadi ber (*Ziziphus nummularia*) and Kair (*Capparis decidua*), Muravli (*Lycium barbarum*), Khejari (*Prosopis cineraria*), Kankeda (*Maytenus emarginata*), and Deshi Babul (*Acacia senegal*).

Though hundreds of floral species (all plant species, including herb, shrub and trees) have been described from the area (Bhandari, 1990), some are of immense economic importance to the local communities. They include Hingoti (*Balanaitis egyptiaca*), Muravli (*Lycium barbarum*), Kair (*Capparis decidua*), Jhari Ber (*Zizyphus nummularia*), Bordi (*Zizyphus mauritiana*), Meethi Jaal or Peelu (*Salvadora persica*) and Khari Jaal (*Salvadora oleoides*), only Gymnosperm plant of Thar Desert, *i.e*., Unt Phog (*Ephedra foliata*), Aak (*Calotropis procera*) and Lana (*Haloxylon salicornicum*) (Bhandari 1990). The local communities also use Kheimp (*Laptadenia pyrotechnica*) to thatch their houses, huts and to make ropes.

The dominant species of these Orans included Khejri (*Prosopis cineraria*), Kair (*Capparis decidua*), Jhari Ber (*Zizyphus nummularia*), Bordi (*Zizyphus mauritiana*) and Piloo (*Salvadora oleoidis*). They were followed by Bhui (*Aerva pseudotomentosa*), Gokhru or Kanti (*Tribulus terrestris,* Kheimp (*Leptadenia pyrotechnica*), Shinia (*Crotalaria burhia*), Biyani (*Tephrosia purpurea*) and Dhamasa (*Fagonia cretica*). The grass species included Dhaman (*Cenchrus ciliaris*) and Bhurat (*Cenchrus setigerus* and *Cenchrus biflorus*). Due to its ever-changing capabilities with respect to the species composition of flora over the time with ecological succession, groves show their dynamics. Resulting of this, clusters of varieties of trees help them not only to sustain biodiversity but also intensify with time. These sacred groves complement national parks, sanctuary and other protected areas (Khandal, 2014). Because of cultural restriction of access to and interference with sacred groves to reduce the human impact, the sacred groves have been evolved as reservoirs of biodiversity and germplasm allowing the complex and diverse array of ecological processes to continue uninterruptedly over long period of time (Yelvattimath and Kotresha, 2011, Gokhale *et.al*, 2011). The religious or cultural designation of an area as sacred promotes the conservation of its associated biodiversity (Maru and Patel, 2013). Many a times these sacred groves show greater diversity in terms of number of species and their importance as compared to the nearby forest areas, which are generally due to monoculture of 36 species of plantation in forest areas (Singh, 2008). Pushpangadan *et al,* (1998) observed 722 species of angiosperm in a sacred grove in Kerala with only 1.4 km^2 as compared to 960 species occurred in 90 sq. km of the Silent Valley Forest. Many endangered, rare and endemic species and their wild relatives find their place in these sacred groves. Some of them are *Phoeba hainsiana*, *Rhus hookeri* and *Flacourtia cataphracta* in sacred groves of Manipur (Haridasan and Rao, 1985), *Kunstleria keralensis* (Mohanan and Nair 1981), *Belpharistemma embranifolia*, *Buchanania lanceolata*, *Syzygium travuncoricum* and *Cinnamomum quilonensis* in sacred groves of Kerala (Nair and Mohanan, 1981; Unnikrishnan, 1995) and *Myristica malabarica*, *Garcinia gummi-gutta* and wild pepper in sacred groves of Karnataka (Chandran *et al.,* 1998). Some of the rare plants observed in orans of Rajasthan are *Acacia catechu*, *Acacia nilotica*, *Anogeissus serecea*, *Blephariss sindica*, *Boswellia serrata*, *Caralluma edulis*, *Ficus bengalensis*, *Ficus glomerata*, *Ficus religiosa*, *Glossonema varians*, *Haloxylon recurvum*, *Commiphora wightii*, *Tribulus rajasthanensis, Zizyphus* spp. etc. (Singh, 2008; Meena and Singh, 2012; Rathore and Shekhawat, 2012). The

orans of Rajasthan provide shelter and shade for the human and wildlife in extreme hot summer days when temperature reaches 40°C. Apart from providing economic benefits of fuel, wood, food – fodder, they provide livelihoods to locals and somewhat small forest produce like medicinal plants, honey, local berries and fruits, which they either use or sell in local market. The variety of grass collected are used to weave basket and leaves are used to make brooms.

3.4. Faunal Diversity

These orans are famous for their conservation stories. A wide range of lower group of invertebrates, including list of ants, termites, dung beetles and spiders are enumerated. 22 species of ants (Table 1), 37 species of dung beetles (Table 2) and 25 species of spiders of 12 different families (Table 3) were observed during the study period.

3.4.1. Ant fauna diversity: Ants are polymorphic social insects having three distinct forms - the perfect and fertile female, the male, and the worker (major or minor). The largest forms are the soldiers. Identification is based mainly on the worker caste of ants. A total of 22 species of Ants (Table 1) from all these Oran landscape have been documented and identified with the help of experts at Desert Regional Centre, Zoological Survey of India, Jodhpur.

Table 1. Ants Fauna (Hymenoptera: Formicidae) of orans of the Jodhpur

S. No.	Scientific Name
1	*Dorylus* (*Typhlopone*) *labiatus* Shuckard
2	*Anochetus punctiventris* Mayr
3	*Tetraponera* (*Tetraponera*) *rufonigra* Jerdon
4	*Tapinoma* (*Micromyrma*) *melanocephalum* Fabricius
5	*Monomorium* (*Monomorium*) *latinode* Mayr
6	*Monomorium* (*Lampromyrmex*) *atomus* Forel
7	*Monomorium* (*Monomorium*) *pharaonis* Linne
8	*Monomorium* (*Monomorium*) *wroughtoni* Forel
9	*Monomorium* (*Holcomyrmex*) *criniceps* Mayr
10	*Monomorium* (*Holcomyrmex*) *glabrum* Ern Andre
11	*Monomorcum* (*Holcomyrmex*) *scabriceps* Mayr
12	*Monomorium* (*Parholcomyrmex*) *destructor* Jerdon
13	*Monomorium* (*Parholcomyrmex*) *gracillimum* var. *mayri* Forel
14	*Monomorium* (*Xeromyrmex*) *salomonis indicum* Forel
15	*Pheidole* (*Pheidole*) *wroughtoni* Forel
16	*Tetramorium salvatum* Forel
17	*Camponotus* (*Tanaemyrmex*) *compressus* Fabricius
18	*Camponotus* (*Tanaemyrmex*) *irritans* Smith
19	*Camponotus* (*Tanaemyrmex*) *mitis* Smith
20	*Componotus* (*Tanaemyrmex*) *taylori*
21	*Cataglyphis bicolor setipes* Emery
22	*Acantholepis frauenfeldi* Emery

3.4.2. Dung Beetle diversity: Dung beetles belongs to Scarabaeidae (Coprinae) family, forms one of the largest beetle families in the world, and are economically important because of their significant roles in pasture ecosystem dynamics and environmental health. They process large amounts of animal dung into nodules or balls, and roll these into subterraneous chambers or tunnels where they are degraded, thereby increasing soil fertility. In so doing, the beetles destroy the habitats of larvae of many pests of domestic animals, including flies which lay their eggs in the dung. Some beetle species are intermediate hosts for parasites of domestic and wild animals. A total of 37 species of dung beetles (Table 2) have been documented and identified with the help of experts at Desert Regional Centre, Zoological Survey of India, Jodhpur.

Table 2. Dung Beetles (Coleoptera–Scarabaeidae–Coprinae) of orans of Jodhpur

Class: Insecta Order: Coleoptera Suborder: Polyphaga
Superfamily: Scarabaeoidea Family: Scarabaeidae Subfamily: Coprinae

S. No.	Scientific Name
1	*Scarabaeus sacer* Linnaeus
2	*Scarabaeus gangaticus* Castelnau
3	*Scarabaeus brahminus* Castelnau
4	*Scarabaeus cristatus* Fabricius
5	*Scarabaeus andrewesi* Felsche
6	*Scarabaeeus erichsoni* Harold
7	*Gymnopleurus cyaneus* Fabricius
8	*Gymnopleurus miliaris* Fabricius
9	*Gymnopleurus koenigi* Fabricius
10	*Heliocopris gigas* Linnaeus
11	*Heliocopris tyrannus* Thomson
12	*Heliocopris dominus* Bates
13	*Catharsius molossus* Linnaeus
14	*Catharsius inermis* Castelnau
15	*Copris delicatus* Arrow
16	*Phalops divisus* Wiedeman
17	*Caccobius torticornis* Arrow
18	*Caccobius meridionalis* Boucomont
19	*Caccobius indicus* Harold

S. No.	Scientific Name
20	*Caccobius pantherinus* Arrow
21	*Caccobius denticollis* Harold
22	*Onthophagus variegatus* Fabricius
23	*Onthophagus fuscopunctatus* Fabricius
24	*Onthophagus troglodyta* Wiedeman
25	*Onthophagus catta* Fabricius
26	*Onthophagus bonasus* Fabricius
27	*Onthophagus seniculus* Fabricius
28	*Onthophagus kuluensis* Bates
29	*Onthophagus angus* Gillet
30	*Onthophagus tragus* Fabricius
31	*Onthophagus ensifer* Boucomont
32	*Oniticellus pallipes* Fabricius
33	*Oniticellus cinctus* Fabricius
34	*Onitis siva* Gillet
35	*Onitis lama* Lansberge
36	*Onitis philemon* Fabricius
37	*Onitis brahma* Lansberge

3.4.3. Spider diversity: A total of 25 species of spiders belonging to 12 families and 21 genera were recorded for Jodhpur district of Rajasthan (Table – 3). Most of the spiders were non-weavers. *Neoscona* sp., *Herennia ornatissima* and *Stegodyphus sarasinorum* were the only weavers.

Table 3. Spider fauna of orans of Jodhpur

S. No.	Scientific Name
Family: Lycodidae	
1	*Lycosa madani* Pocock
2	*Lycosa* sp.
3	*Pardosa sumatrana* (Thorell)
4	*Pardosa heterophthalma* (Simon)
5	*Pardosa pusiola* (Thorell)
6	*Pardosa* sp.
7	*Hippasa* sp.
Family: Araneidae	
8	*Neoscona* sp.
Family: Thomisidae	
9	*Ozyptila chandosiensis* Tikader
10	*Synaema* sp.
Family: Philodromidae	
11	*Tibellus* sp.
Family: Heteropodidae	
12	*Heteropoda fabrei* Simon
Family: Salticidae	
13	*Marpissa* sp.

S. No.	Scientific Name
Family: Sparassidae	
14	*Sparassus* sp.
Family: Gnaphosidae	
15	*Zelotes nasikensis* Tikader & Gajbe
16	*Poecilochroa sedula* (Simon)
17	*Poecilochroa* sp.
18	*Drassodes parvidens* Caporiacco
19	*Drassodes luridus* (O.P. Cambridge)
20	*Gnaphosa* sp.
Family: Oecobiidae	
21	*Uroctea indica* Pocock
Family: Corinnidae	
22	*Aetius* sp.
23	*Castianeria* sp.
Family: Miturgidae	
24	*Cheiracanthium* sp.
Family: Oxyopidae	
25	*Peucetia* sp.

3.4.4. Avifaunal diversity: Birds in the ecosystem are superb ecological indicators and plays multi facet roles of potential pollinators, scavengers and bio-monitors for pest insect control. Large varieties of birds were observed with a total of 121 species belonging to 45 families (Table 4a, 4b & 4c). Chhangani (2002) also studied in and around Jodhpur city and reported 156 species. Family Motacillidae, represented seven species of birds. Scolopacidae and Accipitridae family had a maximum of ten no of species. Accipitridae family, included Shikra, kites, vultures, buzzards, harriers and eagles.

Table 4a. Birds of Oran and its adjoining area

S. No	Family	Common Name	Scientific Name
1.	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*
2.	Phlacrocoracidae	Large Cormorant	*Phalacrocorax carbo*
3.		Little Cormorant	*Phalacrocorax niger*
4.	Ardeidae	Little Egret	*Egretta garzetta*
5.		Grey Heron	*Ardea cinerea*
6.		Indian Pond Heron	*Ardeola grayii*
7.		Intermediate Egret	*Mesophoyx intermedia*
8.		Cattle Egret	*Bubulcus ibis*
9.		Indian Pond-Heron	*Ardeola grayii*
10.	Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*
11.		Black-headed Ibis	*Threskiornis melanocephalus*
12.		Red-naped Ibis	*Pseudibis papillosa*
13.		Eurasian Spoonbill	*Platalea leucorodia*
14.	Phoenicopteridae	Greater Flamingo	*Phoenicopterus rubber*
15.	Anatidae	Gadwall	*Anas strepera*
16.		Mallard	*Anas platyrhynchos*
17.		Indian Spot-billed Duck	*Anas poecilorhyncha*
18.		Northern Shoveller	*Anas clypeata*
19.		Northern Pintail	*Anas acuta*
20.		Common Teal	*Anas crecca*
21.		Common Pochard	*Aythya farina*
22.		Tufted Pochard	*Aythya fuligula*
23.	Accipitridae	Black-shouldered Kite	*Elanus caeruleus*
24.		Black Kite	*Milvus migrans*
25.		Black-eared Kite	*Milvus (migrans) lineatus*
26.		Shikra	*Accipiter badius*
27.		Eurasian Griffon	
28.		Long-billed Vulture	
29.		Egyptian Vulture	*Neophron percnopterus*
30.		Western Marsh Harrier	*Circus aeruginosus*
31.		Long-legged Buzzard	*Buteo rufinus*
32.		Steppe Eagle	*Aquilla nipalensis*
33.	Falconidae	Eurasian Kestrel	*Falco tinnunculus*
34.	Phasianidae	Gray Francolin	*Francolinus pondicerianus*
35.		Indian Peafowl	*Pavo cristatus*
36.	Gruidae	Demoiselle Crane	*Grus virgo*
37.	Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*
38.		Eurasian Moorhen	*Gallinula chloropus*
39.		Eurasian Coot	*Fulica atra*
40.	Charadriidae	Little-ringed Plover	*Charadrius dubius*
41.		Red-wattled Lapwing	*Vanellus indicus*
42.		White-tailed Lapwing	*Vanellus leucurus*

Table 4b. Birds of Oran and its adjoining area

S. No	Family	Common Name	Scientific Name
43.	Scolopacidae	Common Snipe	*Gallinago gallinago*
44.		Common Redshank	*Tringa tetanus*
45.		Marsh Sandpiper	*Tringa stagnatilis*
46.		Common Greenshank	*Tringa nebularia*
47.		Green Sandpiper	*Tringa ochropus*
48.		Wood Sandpiper	*Tringa glareola*
49.		Common Sandpiper	*Actitis hypoleucos*
50.		Little Stint	*Calidris minuta*
51.		Ruff	*Philomachus pugnax*
52.		Black-tailed Godwit	*Limosa limosa*
53.	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*
54.	Burhinidae	Indian Stone Curlew	*Burhinus oedicnemus*
55.	Laridae	River Tern	*Sterna aurantia*
56.	Columbidae	Rock Pigeon	*Columba livia*
57.		Red Collared-Dove	*Streptopelia tranquebarica*
58.		Eurasian Collared-Dove	*Streptopelia decaocto*
59.		Laughing Dove	*Streptopelia senegalensis*
60.	Pteroclidae	Chestnut-bellied Sandgrouse	*Pterocles exustus*
61.	Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri*
62.	Cuculidae	Greater Coucal	*Centropus sinensis*
63.	Strigidae	Spotted Owlet	*Athene brama*
64.	Tytonidae	Barn Owl	*Tyto alba*
65.	Apodidae	Little Swift/House Swift	*Apus affinis*
66.	Alcedinidae	Pied Kingfisher	
67.		White-breasted Kingfisher	*Halcyon smyrnensis*
68.	Meropidae	Small Bee-eater	*Merops orientalis*
69.		Blue-cheeked Bee-eater	*Merops persicus*
70.	Coraciidae	Indian Roller	*Coracias benghalensis*
71.		Eurasian Roller	*Coracias garrulous*
72.	Upupidae	Eurasian Hoopoe	*Upupa epops*
73.	Alaudidae	Ashy-crowned Sparrow-Lark	*Eremopterix griseus*
74.		Rufous-tailed Lark	*Ammomanes phoenicura*
75.		Indian Bushlark	*Mirafra erythroptera*
76.		Crested Lark	*Galerida cristata*
77.	Hirundinidae	Plain Martin	*Riparia paludicola*
78.		Dusky Crag Martin	*Ptyonoprogne concolor*
79.		Red-rumped Swallow	*Cecropis daurica*
80.		Streak-throated Swallow	*Hirundo fluvicola*
81.	Motacillidae	White Wagtail	*Motacilla alba*
82.		White-browed Wagtail	*Motacilla maderaspatensis*
83.		Citrine Wagtail	*Motacilla citreola*
84.		Gray Wagtail	*Motacilla cinerea*
85.		Paddy-field Pipit	*Anthus rufulus*
86.		Long-tailed Pipit	*Anthus similis*
87.		Tawny Pipit	*Anthus campestris*
88.	Tephrodornithidae	Common Woodshrike	*Tephrodornis pondicerianus*
89.	Pycnonotidae	White-eared Bulbul	*Pycnonotus leucotis*
90.		Red-vented Bulbul	*Pycnonotus cafer*
91.	Laniidae	Isabelline Shrike/Rufous-tailed Shrike	*Lanius isabellinus*
92.		Long-tailed Shrike/Rufous-backed Shrike	*Lanius schach*
93.		Southern Grey Shrike	*Lanius meridionalis*

Table 4c. Birds of Oran and its adjoining area

S. No	Family	Common Name	Scientific Name
94.	Muscicapidae	Bluethroat	*Luscinia svecica*
95.		Indian Robin	*Saxicoloides fulicata*
96.		Black Redstart	*Phoenicurus ochruros*
97.		Pied Bushchat	*Saxicola caprata*
98.		Common Stonechat	*Saxicola torquatus*
99.		Indian Chat/ Brown Rock Chat	*Cercomela fusca*
100.		Desert Wheatear	*Oenanthe deserti*
101.		Variable Wheatear	*Oenanthe picata*
102.	Leiothrichidae	Common Babbler	*Turdoides caudate*
103.		Large Gray Babbler	*Turdoides malcolmi*
104.	Sylviidae	Common Lesser Whitethroat	*Sylvia curruca*
105.		Asian Desert Warbler	*Sylvia nana*
106.	Cisticolidae	Common Tailorbird	*Orthotomus sutorius*
107.		Plain Prinia	*Prinia inornata*
108.	Phylloscopidae	Common Chiffchaff	*Phylloscopus collybita*
109.	Nectariniidae	Purple Sunbird	*Nectarinia asiatica*
110.	Estrildidae	Indian Silverbill	*Lonchura malabarica*
111.	Passeridae	House Sparrow	*Passer domesticus*
112.		Chestnut-shouldered Petronia	*Petronia xanthocollis*
113.	Sturnidae	Brahminy Starling	*Sturnus pagodarum*
114.		Rosy Starling	*Sturnus roseus*
115.		European Starling	*Sturnus vulgaris*
116.		Common Myna	*Acridotheres tristis*
117.		Bank Myna	*Acridotheres ginginianus*
118.	Dicruridae	Black Drongo	*Dicrurus macrocercus*
119.	Rhipiduridae	White-browed Fantail Flycatcher	*Rhipidura aureola*
120.	Corvidae	House Crow	*Corvus splendens*
121.		Raven	*Corvus corax*

3.4.5. Mammals of the oran: The orans shared a vivid mammalian fauna (Table 5) with its adjoining are facilitating Desert fox (*Vulpes vulpes pussilla*), Bluebull/Nilgai/Rojara (*Boselaphus tragocamelus*) and Chinkara (*Gazella bennettii*). Local fauna in the habitat helped herbivorous to flourish there. Desert cat (*Felis libica ornata*), which is rare and elusive, was reported by the locals. Apart from these, other common mammals included, Desert Hare (*Lepus nigricolis dayanus*), which is subspecies of Black-naped Hare and Long-eared Hedgehog (*Hemiechinus auritus*) and few Gerbils. Wild Pigs (*Sus scrofa*), also were seen during study along with reported by locals as they destroyed their crops. Apart from this, separate check lists of reptile species (Table 6) enumerated to document the diversity of reptiles.

3.5. Major floral diversity

A list of major trees, shrubs and grasses were also generated, which were having high values in the local culture, biodiversity, medicinally and economically important to the local communities. A total of 9 tree species, 17 shrub species and 15 climber/twiner/runner species has been documented (Table – 7).

Table 5. Mammals of orans and the adjoining area of Jodhpur

S. No.	Scientific Name and Family	Common Name
Order: Rodentia		
1.	*Hystrix indica* Kerr	Porcupine
Family: Sciuridae		
2.	*Funambulus pennanti* Wroughton	Five Striped or Northern Palm Squirrel
Family: Muridae		
3.	*Tatera indica* (Hardwicke)	Indian Gerbil
4	*Meriones hurrianae* (Jerdon)	Indian Desert Jird
5	*Gerbillus gleadowi* Murray	Little Indian Hairy-footed Gerbil
6	*Gerbillus nanus indus* Thomas	Pygmy Gerbil
7	*Rattus rattus* (Linn.)	House Rat or Black Rat
8	*Millardia gleadowi* (Gray)	Sand-coloured Rat
9	*Mus musculus* (Linn.)	House Mouse
10	*M. platythrix* Bennett	Spiny Field Mouse
11	*M. booduga* Gray	Little Indian Field Mouse
12	*Golunda ellioti* Gray	Indian Bush Rat
13	*Nesokia indica* Gray&Hardwicke	Short-tailed Bandicoot Rat
14	*Bandicota bengalensis* (Gray)	Lesser Bandicoot Rat/Indian Mole Rat
Order: Eulipotyphla, Family: Erinaceidae		
15	*Hemiechinus collaris*	Collared or Desert Hedgehog
16	*Paraechinus micropus*	Indian Hedgehog
Family: Soricidae		
17	*Suncus murinus*	House Shrew
Order: Pholidota, Family: Manidae		
18	*Manis crassicaudata*	Indian Pangolin
Order: Lagomorpha, Family: Leporidae		
19	*Lepus nigricollis dayanus*	Indian Hare/Black –naped hare
Order: Carnivora, Family: Herpestidae		
20	*Herpestes auropunctatus*	Small Indian Mongoose
21	*Herpestes edwardsii*	Grey Mongoose
Order: Chiroptera, Family: Rhinopomatidae		
22	*Rhinopoma microphyllum*	Greater Mouse-tailed Bat
23	*Tephozous nudiventris*	Tomb bat
23	*Rhinopoma hardwickei*	Lesser Mouse-tailed Bat
Order: Carnivora, Family: Canidae		
24	*Canis lupus*	Grey Wolf
25	*Canis aureus*	Golden Jackal
26	*Vulpes vulpes pussilla*	Desert fox
27	*Hyena hyena*	Hyena
27	*Vulpes bengalensis*	Indian fox
Family: Felidae		
28	*Felis chaus*	Jungle cat
29	*Felis silvestris ornata*	Desert cat
Order: Artiodactyla, Family: **Suidae**		
30	*Sus scrofa*	Wild boar
Family: Bovidae		
31	*Boselaphus tragocamelus*	Nilgai
32	*Gazella bennettii*	Indian gazelle
33	*Antelope cervicapra*	Blackbuck

Table 6. Snakes of Oran and its adjoining area of Jodhpur

S. No.	Species Name	Common Name	Venomous/Non venomous
1.	*Ramphotyhlops braminus*	Brahminy Worm Snake	Non venomous
2	*Gongylophis conicus*	Russell's boa	Non venomous
3.	*Coelognathus helena helena*	Trinket snake	Non venomous
4.	*Ptyas mucosa*	Indian rat snake	Non venomous
5.	*Coluber ventromaculatus*	Glossy-bellied racer	Mild venomous
6.	*Spalerosophis atriceps*	Black-headed Royal Snake	Non venomous
7.	*Spalerosophis arenarius*	Red spotted royal snake	Non venomous
8.	*Lytorhynchus paradoxus*	Sind longnose sand snake	Non venomous
9.	*Oligodon taeniolatus*	Russel kukri Snake	Non venomous
10.	*Oligodon arnensis*	Common kukri Snake	Non venomous
11.	*Lycodon striatus*	Barred wolf snake	Non venomous
12.	*Lycodon aulicus*	Indian wolf snake	Non venomous
13.	*Xenochrophis piscator*	Checkered keelback	Non venomous
14.	*Amphiesma stolatum*	buff striped keelback	Non venomous
15.	*Boiga trigonata*	Common Cat Snake	Mild venomous
16.	*Psammophis schokari*	Schokari Sand Racer	Mild venomous
17.	*Psammophis leithii*	Leith's sand snake	Mild venomous
18.	*Bungarus caeruleus*	Common krait	venomous
19.	*Naja naja*	Spectacled cobra	venomous
20.	*Echis carinatus*	Saw-scale Viper	venomous

Table 7. Major plants within Orans of Jodhpur region

S. No.	Scientific Names
Trees Species	
1	*Acacia senegal*
2	*Anogeissus pendula*
3	*Balanites aegyptiaca*
4	*Capparis decidua*
5	*Maytenus emarginatus*
6	*Prosopis cineraria*
7	*Salvadora persica*
8	*Salvadora oleoides*
9	*Tecomella undulata*
Shrubs Species	
1	*Abutilon bidentatum*
2	*Acacia jacquemontii*
3	*Aerva tomentosa*
4	*Calligonum polygonoides*
5	*Calotropis procera*
6	*Commiphora wightii*
7	*Crotalaria burhia*
8	*Euphorbia caudicifolia*
9	*Grewia tenax*
10	*Haloxylon recurvum*
11	*Heliotropium sp*

S. No.	Scientific Names
12	*Leptadenia pyrotechnica*
13	*Lycium barbatum*
14	*Salsola baryosoma*
15	*Sericostoma pauciflorum*
16	*Suaeda fruticosa*
17	*Zizyphus nummularia*
Climbers/ Twiners/Runner species	
1	*Citrullus colosynthis*
2	*Citrullus lanatus*
3	*Cucumis sp*
4	*Cocculus pendulus*
5	*Cenchrus biflorus*
6	*Cenchrus setigerus*
7	*Eragrostis sp*
8	*Cyperus sp.*
9	*Dactyloctenium sindicum*
10	*Dactyloctenium aegyptium*
11	*Lasiurus scindicus*
12	*Dactyloctenium sindicum*
13	*Blepharis sindica*
14	*Melanocenchris jaquemontii*
15	*Oropetium thomaeum*

4. Conclusions

This study is one of the first of its kind to document the bio-cultural diversity of sacred groves, which are called Oran in western Rajasthan. These landscapes are protected by native communities since generations on the basis of their cultural and biological diversity. These places hold high diversity in comparison to the nearby cultivated fields and standing today as relict of the past since ages in the changing land use pattern in the adjoining area. These landscapes should be protected under the Convention of Biological Diversity – 2002 and any of the legal frame of Indian sovereign law.

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