

Records of Faunal Diversity from Selected Sacred Groves in Pune District, India

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Abstract

India has an ancient tradition of conserving nature. Sacred groves are the patches of forests dedicated to a local deity. Sacred groves play an important role of supporting local biodiversity along with the cultural togetherness of local people. Sacred groves are threatened due to number of anthropogenic activities and lack of conservation priority. There are hardly any faunal studies done for sacred groves in Pune District. Faunal studies can provide baseline data for conservation planning. Present study attempts to record and analyze faunal elements such as birds, mammals, butterflies and frogs from sacred groves situated in different geographical settings of Pune District. Field visits to ten sacred grove sites from Pune District and semi-structured interviews with local people were conducted for data collection. Every sacred grove is a distinct ecosystem that exhibits a unique biodiversity profile. Sacred groves are rich in faunal diversity. A number of endemic and IUCN red listed faunal species were recorded from all of the sacred grove sites under this study. Due to their crucial function in maintaining both cultural and environmental well-being, sacred groves need to be protected.

Key words: Sacred groves, Pune district, Birds, Mammals, Butterflies, Frogs, Conservation

All over the world, there are natural areas that are revered by various cultures. Sacred Natural Sites are recognized by IUCN and are defined as “areas of land or water having special spiritual significance to people and communities” [1]. Traditions of worshipping nature are seen in many parts of India. One such important custom is the dedication of small areas of forest to certain deities as sacred groves (*Devrai* or *Dev-Rahat* in vernacular) [2]. Sacred groves have great importance for their spiritual values along with the rich biodiversity they harbour [3]. These traditions can play an important role in conservation because some of the sacred forest fragments represent the sole remaining forests and the last remaining locations with potential for conservation of flora and fauna [4]. For thousands of years, sacred groves have supported local biodiversity and served an ecological purpose. The unique flora and fauna occurring in sacred groves are seriously threatened due to habitat loss, degradation of forests and fragmentation. Pune (18.5204° N, 73.8567° E) District is situated in western Maharashtra with its western boundary defined by the Western Ghats (Sahyadri mountain ranges) and extending eastwards on to the Deccan peninsular region [5]. Sacred groves in Pune District are reported mainly from the Western Ghats region and its eastern slopes [6] especially in the

Talukas – Bhor, Velhe, Mulshi, Maval, Ambegaon, Junnar and Purandar. Most of the sacred groves in Pune District exhibit a small number of montane subtropical evergreen, moist deciduous and some dry deciduous elements [7]. Present study attempts to record and study faunal diversity of selected ten sacred groves situated in different geographical regions of Pune District.

MATERIALS AND METHODS

The study sites represent sacred groves present in different geographical settings and forest types found in Pune District. The study sites are located in villages – Shirgaon (SH-DUR), Bhordi (BH-KEL, BH-SOM), Pishvi (PI-BAH), Kelad (KE-JAN), Ghisar (GH-VAR), Panwadi (PA-LAC), Ajeevali (AJ-WAG), Abhepuri (AB-DHO) and Rajpur (RA-MAH) (Fig 1). Taluka wise location, area surveyed, altitude and dominant habitat type of the study sites are given in (Table 1). GPS locations of the study sites were recorded using GPS, Garmin e-trex30. Field visits were conducted during the years 2018-2022 for studying birds, butterflies, frogs and mammals. Each site was visited twice so as to cover major seasons. Reconnaissance walk [8] and survey transects were conducted

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Table 3 Records of mammals from selected sacred groves in Pune district

S. No.	Family	Common name	Scientific name	Endemism	IUCN Status	WPA	BH-KEL	AJ-WAG	AB-DHO	PA-LAC	RA-MAH	BH-SOM	PI-BAH	KE-JAN	GH-VAR	SH-DUR
1	Cercopithecidae	Bonnet Macaque	<i>Macaca radiata</i>	E	LC	II		+	+	+					+	+
2		Gray Langur / Hanuman Langur	<i>Semnopithecus entellus</i>		NT	II	+	+	+	+	+	+	+	+	+	+
3	Sciuridae	Malabar / Indian Giant Squirrel	<i>Ratufa indica</i>	E	LC	II		+		+						+
4		Three-striped / Indian Palm Squirrel	<i>Funambulus palmarum</i>	E	LC	IV	+	+	+	+	+	+	+	+	+	+
5	Muridae	Greater Bandicoot-rat	<i>Bandicota indica</i>		LC	IV	+	+	+	+	+	+	+	+	+	+
6		Indian Bush Rat	<i>Golunda ellioti</i>		LC	IV	+	+	+	+	+	+	+	+	+	+
7		Little Indian Field Mouse	<i>Mus booduga</i>		LC	V	+	+	+	+	+	+	+	+	+	+
8		House Rat	<i>Rattus rattus</i>		LC	V	+	+	+	+	+	+	+	+	+	+
9	Hystricidae	Indian Crested Porcupine	<i>Hystrix indica</i>		LC	IV			+		+					
10	Leporidae	Black-Naped / Indian Hare	<i>Lepus nigricollis</i>		LC	IV	+	+	+	+	+	+	+	+	+	+
11	Soricidae	House Shrew	<i>Suncus murinus</i>		LC	IV	+	+		+		+		+		+
12	Pteropodidae	Indian Flying Fox	<i>Pteropus giganteus</i>		LC	V	+	+	+	+	+	+	+	+	+	+
13	Vespertilionidae	Indian Pipistrelle	<i>Pipistrellus coromandra</i>		LC	V	+	+	+	+	+	+	+	+	+	+
14	Canidae	Golden Jackal	<i>Canis aureus</i>		LC	II		+	+	+			+		+	+
15		Grey Wolf	<i>Canis lupus</i>		LC	I				+	+					
16	Viverridae	Small Indian Civet	<i>Viverricula indica</i>	E	LC	II	+	+	+	+	+	+	+	+	+	+
17		Common Palm Civet	<i>Paradoxurus hermaphroditus</i>		LC	II	+	+	+			+	+	+	+	+
18	Herpestidae	Indian Grey Mongoose	<i>Herpestes edwardsii</i>		LC	II	+	+	+	+	+	+	+	+	+	+
19	Hyaenidae	Striped Hyena	<i>Hyaena hyaena</i>		NT	III				+	+					
20	Suidae	Wild Boar	<i>Sus scrofa</i>		LC	III	+	+	+	+	+	+	+	+	+	+
21	Cervidae	Barking Deer	<i>Muntiacus muntjak</i>		LC	III	+	+	+		+	+	+	+	+	+
22	Bovidae	Indian Gaur	<i>Bos gaurus</i>		VU	I					+					
23		Deccan Chinkara	<i>Gazella bennettii</i>	E	LC	I				+						
24		Blackbuck	<i>Antelope cervicapra</i>		EN	I				+						
25	Felidae	Jungle Cat	<i>Felis chaus</i>		LC	II	+	+	+	+	+	+	+	+	+	+
26		Rusty-spotted Cat	<i>Prionailurus rubiginosus</i>		VU	I	+	+	+	+	+	+	+	+	+	+
27		Leopard	<i>Panthera pardus</i>		NT	I	+	+	+	+	+	+	+	+	+	+
28	Tragulidae	Indian Chevrotain / Mouse Deer	<i>Moschiola indica</i>	E	LC	I		+	+						+	+
29	Manidae	Indian Pangolin	<i>Manis crassicaudata</i>		EN	I				+	+					
Total number of species							18	22	21	21	24	17	18	17	21	21

Endemism: E: Endemic IUCN Status: LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered

A total of 29 species of mammals representing 19 families were observed (Table 3). Muridae and Felidae are dominant families with 4 and 3 species respectively. Twelve families of mammals are represented by only 1 species each whereas the remaining with 2 species each. Sacred grove RA-MAH harbours the most i.e., 83% of the total mammal species observed, whereas the least i.e., 59% of the total mammal species were observed at KE-JAN and BH-SOM each. Six study sites showed presence of over 70% of the total mammal species each. Indian giant squirrel, the state animal of Maharashtra, was found at only three sites, AJ-WAG, RA-MAH and GH-WAR. Among mammals, Wild Boars created

level 4 nuisance to the paddy fields, whereas Leopard nuisance as predated on livestock was rated as 3 across sites.

A total of 39 species of butterflies representing 6 families were observed (Table 4). Nymphalidae is the dominant family represented by 15 species followed by Biblidinae with 7 species. Only 1 family of butterflies is represented by a single species. Sacred groves SH-DUR and BH-KEL harbours the most i.e., 85% and 82% of the total butterfly species observed, whereas the least i.e., 31% of the total butterfly species observed were observed at BH-SOM. Blue Mormon, State butterfly of Maharashtra, was found at all sites except at PA-LAC.

Table 4 Records of butterflies from selected sacred groves in Pune district

S. No.	Family	Common name	Scientific name	Endemism	IUCN Status	WPA	BH-KEL	AJ-WAG	AB-DHO	PA-LAC	RA-MAH	BH-SOM	PI-BAH	KE-JAN	GH-VAR	SH-DUR
1	Biblidinae	Angled Castor	<i>Ariadne ariadne L.</i>	NE		+	+			+	+		+	+		+
2		Blue Pansy	<i>Junonia orithiya L.</i>	LC			+	+		+	+				+	+
3		Chocolate Pansy	<i>Junonia iphita C.</i>	NE				+					+	+	+	+
4		Common Castor	<i>Ariadne merione C.</i>	NE			+		+					+	+	
5		Danaid Egg Fly	<i>Hypolimnas misippus L.</i>	LC		+	+	+		+			+	+		+
6		Lemon Pansy	<i>Junonia lemonias L.</i>	NE		+	+	+					+			
7		Yellow Pansy	<i>Junonia hierta F.</i>	LC				+								+
8	Hesperiida	Asian Grizzled Skipper	<i>Spialia galba F.</i>	NE			+						+			
9	Lycaenida	Common Cerulean	<i>Jamides celeno C.</i>	NE		+	+	+	+	+					+	+
10	e	Gram Blue	<i>Euchrysops cnejus F.</i>	NE			+		+	+			+		+	+
11		Monkey Puzzle	<i>Rathinda amor F.</i>	NE		+	+			+	+		+		+	
12		Plum Judy	<i>Abisara echerius S.</i>	NE		+		+					+			+
13		Red Pierrot	<i>Talicauda nyseus Guerin M</i>	NE		+	+	+	+	+			+	+	+	+
14	Nymphalidae	Blue Tiger	<i>Tirumala limniace C.</i>	LC		+	+	+					+		+	+

15	Common Baron	<i>Euthalia aconthea</i> C.	NE		+	+	+		+	+	+	+			
16	Common Bush Brown	<i>Mycalesis perseus</i> F.	LC			+	+	+	+			+			
17	Common evening brown	<i>Melanitis leda</i> L.	LC		+	+	+	+	+	+	+	+			
18	Common Indian Crow	<i>Euploea core</i> C.	LC		+	+	+	+	+	+	+	+			
19	Common Leopard	<i>Phalanta phalantha</i> D.	LC			+		+			+	+			
20	Common Map	<i>Cyrestis thyodamas</i> B.	NE		+		+			+		+			
21	Common Sailor	<i>Neptis hylas</i> L.	NE		+	+	+		+	+	+	+			
22	Common Three Ring	<i>Ypthima asterope</i> K.	LC		+	+				+		+			
23	Glassy Tiger	<i>Parantica aglea</i> S.	NE	II	+	+	+			+		+			
24	Joker	<i>Byblia ilithyia</i> D.	LC			+		+				+			
25	Plain Tiger	<i>Danaus chrysippus</i> L.	LC		+	+		+	+			+			
26	Sahyadri Blue Oak-leaf	<i>Callima horsfieldii</i> K.	E	NE	+	+	+			+		+			
27	Sargent	<i>Athyma perius</i> L.	NE		+	+	+			+		+			
28	Striped Tiger	<i>Danaus genutia</i> C.	NE		+	+	+	+	+	+	+	+			
29	Papilionida	Blue Mormon	NE		+	+	+	+	+	+	+	+			
30	e	Common Blue Bottle	LC			+	+					+			
31		Common Mormon	NE		+	+	+			+	+	+			
32		Crimson Rose	E	LC	I	+	+	+	+	+	+	+			
33		Red Helen	LC		+	+	+		+	+		+			
34	Pieridae	Common Emigrant	NE		+	+	+	+	+	+	+	+			
35		Common grass yellow	LC		+	+	+	+	+	+	+	+			
36		Common Jezebel	NE		+	+	+	+	+	+	+	+			
37		Common Wanderer	NE			+		+	+			+			
38		Three spot grass yellow	NE		+	+	+	+	+	+	+	+			
39		White Orange Tip	NE		+			+	+			+			
Total number of species						32	31	29	19	22	12	28	18	25	33

Endemism: E: Endemic IUCN Status: NE: Not Evaluated, LC: Least Concern

Table 5: Records of Frogs from Selected Sacred Groves in Pune District

S. No.	Family	Common name	Scientific name	Endemic Status	RET Status	BH-KEL	AJ-WAG	AB-DHO	PA-LAC	RA-MAH	BH-SOM	PL-BAH	KE-JAN	GH-VAR	SH-DUR
1	Bufo	Black-spectacled toad	<i>Duttaphrynus melanostictus</i>		LC	+	+	+				+	+	+	+
2	Dicroglossidae	Indian skipping frog	<i>Euphylyctis cyanophlyctis</i>		LC	+		+	+					+	+
3		Rufescent burrowing frog	<i>Minervarya rufescens</i>	E	LC	+			+	+				+	+
4		Bombay wart frog	<i>Minervarya syhadrensis</i>		LC	+	+		+	+		+	+	+	+
5		Indian bull frog	<i>Hoplobatrachus tigerinus</i>		LC	+	+		+	+		+			+
6		Indian burrowing frog	<i>Sphaerotheca breviceps</i>		LC		+		+	+		+			+
7		Indian cricket frog	<i>Fejervarya limnocharis</i>		LC	+	+		+	+		+	+	+	+
8	Microhylidae	Ornate narrow-mouthed frog	<i>Microhyla ornata</i>		LC		+	+				+	+		+
9	Ranixalidae	Beddome's leaping frog	<i>Indirana beddomii</i>	E	LC	+	+		+			+	+		+
10	Rhacophoridae	Spotted tree frog	<i>Polypedates maculatus</i>		LC	+	+	+		+	+	+	+	+	+
11		Castle rock bush frog	<i>Raorchestes bombayensis</i>	E	V										
TOTAL Number of Species						U	+	+	+	+	+	+	+	+	+
							9	9	5	7	7	2	9	7	11

Endemism: E: Endemic IUCN Status: LC: Least Concern, VU: Vulnerable

A total of 11 species of frogs representing 5 families were observed (Table 5). Dicroglossidae is the dominant family represented by 6 species. Three families of frogs are represented by only 1 species each. Sacred groves SH-DUR harbours the most i.e., all 100% the frog species observed, whereas the least i.e., 18% of the total frog species were observed at BH-SOM.

The selected study sites show diverse faunal elements. Seventeen species of birds were found at all the ten study sites whereas ten bird species were found only at one site. Fourteen species of mammals were found at all the ten sites whereas three mammal species were found only at one site. Seven species of butterflies were found at all the ten study sites whereas least i.e., two butterfly species were found at two sites. Two species of

frogs were found at nine sacred groves whereas four species of frogs were found at five sacred groves. This makes each sacred grove a very unique ecosystem with respect to the natural distribution of these faunal elements.

Species richness, defined as the number of species per unit area, is perhaps the simplest measure of biodiversity; understanding the factors that affect and are affected by small scale species richness is fundamental to community ecology [17]. BH-SOM shows highest number of species per acre for birds (21), mammals (8.5) and butterflies (6) whereas KE-JAN shows it for frogs (1.75) (Table 6). AJ-WAG shows lowest number of species per acre for birds (1.3), Mammals (0.55), butterflies (0.78) and frogs (0.23). Geographical locations of the

study sites, vegetation type, surrounding habitats, acreage assessed and disturbances like habitat fragmentation, canopy loss and the effects of grazing might all be contributing factors to the difference in species richness levels seen among these sites. Higher number of species at BH-SOM despite its smallest area could be due to its thick and diverse vegetation and its critical location as roosting or hiding place while commuting among the nearby habitats. Also, BH-SOM shows variety of habitats in its surrounding area. Lower number of species at AJ-WAG could be due to its largest expanse with comparatively less tree diversity and more disturbance levels. In all of these sacred groves, semi-evergreen and moist deciduous vegetation communities predominate. However, all of these sites are surrounded by a mix of agriculture, grazing land, fallow land, and stunted forest, which also contribute to the species richness. Exotic weeds, interspecific competition and their impacts on the vegetation and in turn on native fauna are threats that are almost irreversible [18]. Understanding of the factors that influence species richness is particularly important for applying the concept to biodiversity conservation [17] and its prioritization.

Table 6 Faunal species richness (No. of species per acre) at study sites

Study site	No. of species per acre			
	Birds	Mammals	Butterflies	Frogs
BH-KEL	2.27	0.60	1.07	0.30
AJ-WAG	1.30	0.55	0.78	0.23
AB-DHO	3.35	1.24	1.71	0.29
PA-LAC	5.50	2.63	2.38	0.88
RA-MAH	1.81	1.50	1.38	0.44
BH-SOM	21.00	8.50	6.00	1.00
PI-BAH	11.00	3.60	5.60	1.80
KE-JAN	9.00	4.25	4.50	1.75
GH-VAR	2.06	1.17	1.39	0.39
SH-DUR	3.88	1.24	1.94	0.65

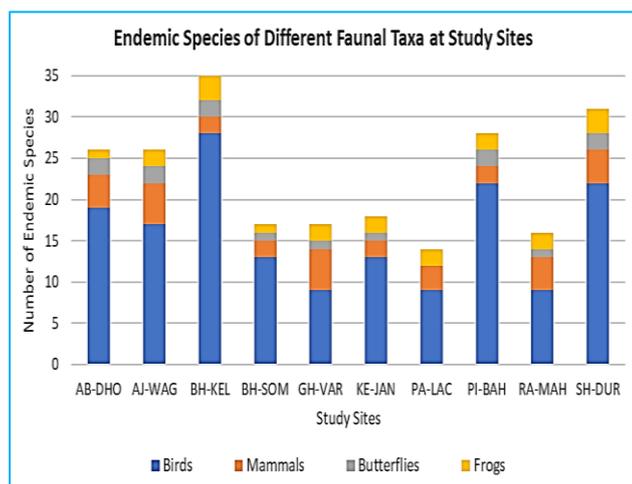


Fig 2 Endemic faunal species at the study sites

Faunal data were further analyzed for presence of rare, endangered and threatened species based on the IUCN Red List of Threatened Species [14] and for presence of endemic species at each site. All the sacred grove sites showed presence of different endemic (Fig 2) and IUCN Red Listed (Figure 3) species of either of the studied faunal taxonomic groups. Endangered mammal Indian Pangolin was reported from PA-LAC and RA-MAH; and Blackbuck from PA-LAC. Presence of RET and endemic species in the study sites indicate that these sites need priority in conservation agenda [14], [19]. As per

WPA, 9 species of birds, 8 species of mammals and 1 species of butterflies found in selected sacred groves are protected under Schedule-I, while 8 species of mammals and 1 species of butterflies under Schedule-II, whereas 87 species of birds and 6 species of mammals are protected under Schedule-IV. Four species of mammals found are part of Schedule V. Sacred groves often comprise of a range of microhabitats including dense vegetation, under-storey shrubs, rocky cliffs, caves, tree-hollows in old growth trees, fallen trees, streams, seasonal puddles, rock patches and grass patches. Sites AJ-WAG, BH-KEL, PI-BAH, AB-DHO and SH-DUR show presence of critically endangered bird species – Indian Vulture due to presence of habitat of rocky cliffs in and around these sacred groves. Forests with good canopy cover support upper canopy dwelling mammals like Indian giant squirrels, which travel from tree to tree [20]. In turn, the species is also important as agent of seed dispersal [21]. Higher diversity of butterflies inside sacred groves can be acknowledged to the network of streams and presence of their specific food and host plants. Presence of nectar rich invasive plants like *Chromolaena odorata* and *Lantana camara* [5] are also contributing factors for higher butterfly diversity. Streams and seasonal puddles provide breeding grounds for frogs.

Certain faunal species are also worshipped in traditional cultures. Local communities follow a taboo against hunting of wild animals inside sacred groves [22]. Sacred groves play an important role as corridors and day hiding places for many of these faunal species. Once part of a continuous forest patch, these sacred groves are turning into island ecosystems due to exploitation of natural resources and deforestation for livelihood purposes and urban development [23].

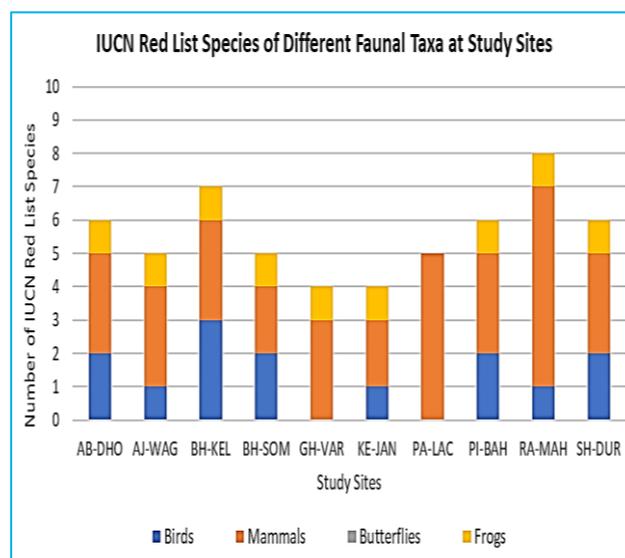


Fig 3 IUCN red listed faunal species at the study sites

CONCLUSION

Present study helps in establishing baseline data related to faunal diversity of sacred groves in this region. Sacred groves harbour climax vegetation and are home to important endemic and globally and locally rare and vulnerable species of plants and dependent animals. This study throws light on the intimate relationship and associations between these critical habitats and faunal diversity reported at these places. Birds, mammals and butterflies play an important role in pollination and seed dispersal of many plant species. Along with geographical settings and vegetation patterns, factors such as climatic conditions and changes in surrounding landscape influence the

faunal elements present in the sacred groves. Each sacred grove is a unique ecosystem and displays its unique characteristic faunal profile, which needs to be considered while planning for conservation.

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