

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

Mukul Mahabaleshwarkar<sup>\*1,3</sup>, Nivedita Ghayal<sup>1,2</sup> and Supriya Mahabaleshwarkar<sup>3</sup>

<sup>1</sup>Annasaheb Kulkarni Department of Biodiversity, MES Abasaheb Garware College, Pune - 411 004, Maharashtra, India

<sup>2</sup>Department of Botany, MES Abasaheb Garware College, Karve Road, Pune - 411 004, Maharashtra, India

<sup>3</sup>Indian National Trust for Art and Cultural Heritage (INTACH) Pune Chapter, Kothrud, Pune - 411 038, Maharashtra, India

## 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 – Bhore, 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

Received: 20 Jun 2023; Revised accepted: 22 Aug 2023; Published online: 14 Sep 2023

**Correspondence to:** Mukul Mahabaleshwarkar, Annasaheb Kulkarni Department of Biodiversity, MES Abasaheb Garware College, Pune - 411 004, Maharashtra, India, Tel: +91 9881585777; E-mail: mmukul@gmail.com

**Citation:** Mahabaleshwarkar M, Ghayal N, Mahabaleshwarkar S. 2023. Records of faunal diversity from selected sacred groves in Pune District, India. *Res. Jr. Agril. Sci.* 14(5): 1244-1250.

across and around sacred groves so as to cover maximum habitat types represented in the groves. Checklists of birds, butterflies, mammals and frogs observed during the walk transects were prepared based on their encounters. Identifications were done using the relevant field guides for the selected taxonomic groups [9-13]. Mammals are hard to site so informal discussions with local people were also conducted to know about presence of large mammals. Data were analyzed for endemism, IUCN Red List [14] status and schedule as per The Wild Life (Protection) Act (WPA), 1972 [15] for the observed taxa. Data were further analyzed for feeding habits and migration status of birds. Survey was also carried out with farmers around the grove to understand if there is any faunal element which is creating nuisance to their farms and about human-wildlife conflict. The nuisance levels were rated from 0 to 5 with 0 as no nuisance and 5 as maximum nuisance level.

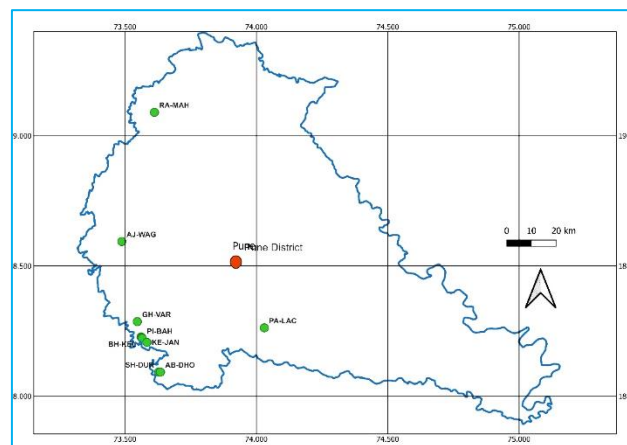


Fig 1 Map of Pune district showing locations of study sites

Table 1 Details of selected study sites

S. No.	Study site	Taluka	Study area (Acres)	Altitude (mASL)	Dominant habitat type
1	BH-KEL	Velhe	30	683	Semi-evergreen, Moist Deciduous
2	AJ-WAG	Maval	40	820	Semi-evergreen
3	AB-DHO	Bhor	17	700	Evergreen, Semi-evergreen
4	PA-LAC	Purandar	8	817	Moist deciduous
5	RA-MAH	Ambegaon	16	1051	Dry Deciduous, Moist deciduous
6	BH-SOM	Velhe	2	690	Semi-evergreen, Moist Deciduous
7	PI-BAH	Velhe	5	700	Semi-evergreen, Moist Deciduous
8	KE-JAN	Velhe	4	680	Semi-evergreen, Moist Deciduous
9	GH-VAR	Velhe	18	870	Semi-evergreen
10	SH-DUR	Bhor	17	677	Evergreen, Semi-evergreen

## RESULTS AND DISCUSSION

Many studies have been conducted from floristic perspectives of sacred groves. However, there is a dearth of studies to record and monitor associated faunal elements. Faunal surveys at selected sacred grove study sites revealed that:

A total of 96 species of birds representing 45 families were observed (Table 2). Accipitridae and Muscicapidae are dominant families with 7 species each. Twenty-four families of birds are represented by only 1 species each. Sacred groves BH-KEL and SH-DUR harbour the most i.e., 71% and 69% of the total bird species found respectively, whereas the least i.e., 30% of the total bird species were observed at RA-MAH. Yellow

legged green pigeon, the state bird of Maharashtra, was found at all sites except PA-LAC and RA-MAH [16]. Bird species were classified based on their feeding guild and migration status (Table 2). Out of total 96 bird species, 39.6% are insectivores, 20.8% are omnivores, 10.4% are carnivores followed by 9.4%, 8.3%, 7.3% and 4.1% species as granivores, frugivores, piscivores and nectarivores respectively. Diverse habitat types including agriculture in the surroundings of the sacred groves attract many insects and birds. Eighty-six percent species are resident whereas 12.5% are winter migratory and 1% is vagrant. Indian peafowl and Gray junglefowl are considered nuisance species to the agricultural farms around the sacred groves BH-KEL, BH-SOM, PI-BAH, GH-VAR and PA-LAC. Local people there rated the nuisance level as 3.

Table 2 Records of birds from selected sacred groves in Pune district

S. No.	Family	Common name	Scientific name	Feeding Guild	Migration status	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	Accipitridae	Black Kite	<i>Milvus migrans</i>	C	R		LC	I	+			+	+	+	+			+
2		Black Winged Kite	<i>Elanus caeruleus</i>	C	R		LC	I	+	+		+		+				+
3		Brahminy Kite	<i>Haliastur indus</i>	C	R		LC	I	+		+			+	+			+
4		Crested Serpent-Eagle	<i>Spilornis cheela</i>	C	R		LC	I	+	+	+			+	+	+	+	+
5		Indian Vulture	<i>Gyps indicus</i>	C	R	E	CE	I	+	+	+				+			+
6		Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	C	R		LC	I			+							
7		Shikra	<i>Accipiter badius</i>	C	R		LC	I	+	+	+	+	+	+	+	+	+	+
8	Acrocephalidae	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>	I	W		LC	IV		+					+			+
9		Common Iora	<i>Aegithina tiphia</i>	I	R		LC	IV	+	+	+	+	+	+	+	+	+	+
10	Alaudidae	Malabar Lark	<i>Galerida malabarica</i>	O	R	E	LC	IV			+	+	+					+
11	Alcedinidae	Common Kingfisher	<i>Alcedo atthis</i>	P	R		LC	IV	+	+	+						+	
12		White-throated Kingfisher	<i>Halcyon smyrnensis</i>	P	R		LC	IV	+	+	+	+	+	+	+	+	+	+
13	Apodidae	House Swift	<i>Apus nipalensis</i>	I	W		LC	IV				+						
14	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>	P	R		LC	IV	+	+		+	+		+			+
15		Gray Heron	<i>Ardea cinerea</i>	P	R		LC	IV			+							+
16		Indian Pond-heron	<i>Ardeola grayii</i>	P	R		LC	IV	+		+						+	+
17		Little Egret	<i>Egretta garzetta</i>	P	R		LC	IV			+	+						
18	Bucerotidae	Malabar Grey Hornbill	<i>Ocyeroceros griseus</i>	O	R	E	LC	IV	+	+	+			+	+			+
19		Malabar Pied Hornbill	<i>Anthraceroceros coronatus</i>	O	R	E	NT	I	+					+	+			

20	Campephagidae	Scarlet Minivet	<i>Pericrocotus flammeus</i>	I	R		LC	IV	+			+						+
21	Caprimulgidae	Indian Nightjar	<i>Caprimulgus asiaticus</i>	I	R	E	LC	IV	+	+	+			+	+	+	+	+
22	Charadriidae	Red Watted Lapwing	<i>Vanellus indicus</i>	I	R		LC	IV	+	+	+	+	+	+	+	+	+	+
23	Cisticolidae	Ashy Prinia	<i>Prinia socialis</i>	I	R	E	LC	IV	+	+	+	+	+	+	+	+	+	+
24		Common Tailorbird	<i>Orthotomus sutorius</i>	I	R		LC	IV	+	+	+	+	+	+	+	+	+	+
25	Columbidae	Gray-fronted Green Pigeon	<i>Treron affinis</i>	G	R	E	LC	IV	+					+	+			
26		Laughing Dove	<i>Streptopelia senegalensis</i>	G	R		LC	IV	+		+				+	+		+
27		Nilgiri Wood-pigeon	<i>Columba elphinstonii</i>	F	R	E	VU	IV	+	+			+	+				+
28		Western Spotted Dove	<i>Spilopelia suratensis</i>	G	R	E	LC	IV	+	+		+						
29		Yellow-legged Green Pigeon	<i>Treron phoenicopterus</i>	G	R		LC	IV	+	+	+			+	+	+	+	+
30	Coraciidae	Indian Roller	<i>Coracias benghalensis</i>	I	R		LC	IV	+	+	+	+	+	+	+	+	+	+
31	Corvidae	House Crow	<i>Corvus splendens</i>	O	R		LC	IV				+						
32		Jungle Crow	<i>Corvus culminatus</i>	O	R		LC	IV	+	+	+	+	+	+	+	+	+	+
33		Large-billed Crow	<i>Corvus macrorhynchos</i>	O	R		LC	IV	+	+	+	+	+	+	+	+	+	+
34	Cuculidae	Asian (Western) Koel	<i>Eudynamys scolopaceus</i>	F	R		LC	IV	+	+	+	+	+	+	+	+	+	+
35		Common Hawk Cuckoo	<i>Hierococcyx varius</i>	I	R	E	LC	IV	+	+	+	+	+	+	+	+	+	+
36		Greater Coucal	<i>Centropus sinensis</i>	O	R		LC	IV	+	+	+				+			+
37	Dicaeidae	Pale-billed flowerpecker	<i>Dicaeum erythrorhynchos</i>	N	R	E	LC	IV		+						+		+
38		Ashy Drongo	<i>Dicrurus leucophaeus</i>	I	W		LC	IV				+						
39		Black Drongo	<i>Dicrurus macrocerus</i>	I	R		LC	IV	+	+	+	+	+	+	+	+	+	+
40		White-Bellied Drongo	<i>Dicrurus caeruleus</i>	I	R	E	LC	IV				+	+					
41	Estrildidae	Scaly-breasted munia	<i>Lonchura punctulata</i>	I	R		LC	IV	+	+				+			+	+
42	Falconidae	Common Kestrel	<i>Falco tinnunculus</i>	C	R		LC	IV		+		+		+			+	+
43	Hirundinidae	Asian House-Martin	<i>Delichon dasypus</i>	I	W	E	LC	IV				+						+
44		Dusky Crag-Martin	<i>Ptyonoprogne concolor</i>	I	R		LC	IV				+						
45		Eurasian Crag-Martin	<i>Ptyonoprogne rupestris</i>	I	W		LC	IV				+						
46		Red-rumped Swallow	<i>Cecropis daurica</i>	I	R		LC	IV				+		+				
47		Wire Tailed Swallow	<i>Hirundo smithii</i>	I	W		LC	IV	+		+	+				+	+	+
48	Irenidae	Golden-fronted Chloropsis	<i>Chloropsis aurifrons</i>	I	R		LC	IV	+									+
49	Laniidae	Long-tailed Shrike	<i>Lanius schach</i>	I	R		LC	IV				+						
50	Leiothrichidae	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>	O	R	E	LC	IV	+									+
51		Common Babbler	<i>Argya caudata</i>	F	R	E	LC	IV	+	+				+				+
52		Jungle Babbler	<i>Turdoides striata</i>	I	R	E	LC	IV	+	+	+	+	+	+	+	+	+	+
53	Meropidae	Asian Green Bee-eater	<i>Merops orientalis</i>	I	R		LC	IV	+	+	+	+				+	+	+
54	Monarchidae	Black Naped Monarch	<i>Hypothymis azurea</i>	I	R		LC	IV	+		+						+	
55	Motacillidae	Gray Wagtail	<i>Motacilla cinerea</i>	I	W		LC	IV				+	+					+
56		Richard's Pipit	<i>Anthus richardi</i>	I	W		LC	IV			+	+						
57	Muscicapidae	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	I	R		LC	IV			+				+			
58		Indian Robin	<i>Saxicoloides fulicatus</i>	I	R	E	LC	IV	+					+	+	+		+
59		Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	O	W	E	LC	IV	+	+	+				+	+	+	+
60		Oriental Magpie Robin	<i>Copsychus saularis</i>	I	R		LC	IV	+	+	+		+	+	+	+	+	+
61		Pied Bushchat	<i>Saxicola caprata</i>	I	R		LC	IV			+	+						+
62		Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	I	R	E	LC	IV	+	+	+				+	+	+	
63		White-bellied blue Flycatcher	<i>Cyornis pallipes</i>	I	R	E	LC	IV		+	+		+					+
64	Nectariniidae	Crimson-backed Sunbird	<i>Leptocoma minima</i>	N	R	E	LC	IV	+	+					+			
65		Loten's Sunbird	<i>Cinnyris lotenius</i>	N	R	E	LC	IV	+	+								
66		Purple Sunbird	<i>Cinnyris asiaticus</i>	N	R		LC	IV	+		+						+	
67	Oriolidae	Indian Golden Oriole	<i>Oriolus kundoo</i>	O	R		LC	IV	+	+	+			+	+		+	+
68	Passeridae	House Sparrow	<i>Passer domesticus</i>	I	R		LC	IV	+			+		+				+
69	Phalacrocoracidae	Little Cormorant	<i>Microcarbo niger</i>	P	R		LC	IV			+							
70	Phasianidae	Gray Junglefowl	<i>Gallus sonneratii</i>	G	R	E	LC	IV	+	+	+			+	+	+	+	+
71		Indian Peafowl	<i>Pavo cristatus</i>	G	R	E	LC	I	+		+	+	+	+	+			+
72		Jungle Bush Quails	<i>Perdica asiatica</i>	G	R		LC	IV	+	+	+			+	+	+	+	+
73		Painted Francolin	<i>Francolinus pictus</i>	G	R	E	LC	IV	+		+				+			+
74	Phylloscopitade	Greenish Warbler	<i>Phylloscopus trochiloides</i>	I	W		LC	IV				+						+
75		Tyler's Leaf-warbler	<i>Phylloscopus tyleri</i>	I	R	E	NT	IV			+					+		
76	Pittidae	Indian Pitta	<i>Pitta brachyura</i>	I	R	E	LC	IV	+						+			
77	Ploceidae	Baya Weaver	<i>Ploceus philippinus</i>	G	R		LC	IV				+						+
78	Psittaculidae	Malabar Parakeet	<i>Psittacula columboides</i>	O	R	E	LC	IV	+	+								+
79		Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	F	R	E	LC	IV	+						+			
80		Rose-Ringed Parakeet	<i>Psittacula krameri</i>	F	R		LC	IV	+	+	+	+	+	+	+	+	+	+
81		Vernal hanging parrot	<i>Loriculus vernalis</i>	F	V		LC	IV				+						
82	Pycnonotidae	Red-Vented Bulbul	<i>Pycnonotus cafer</i>	O	R		LC	IV	+	+	+	+	+	+	+	+	+	+
83	Pycnonotidae	Red-Whiskered Bulbul	<i>Pycnonotus jocosus</i>	O	R		LC	IV	+	+	+	+	+	+	+	+	+	+
84		Yellow-browed Bulbul	<i>Acrillias indica</i>	O	R	E	LC	IV	+						+			
85	Ramphastidae	Coppersmith Barbet	<i>Megalaima haemacephala</i>	F	R		LC	IV	+	+	+				+	+		+
86		White-cheeked Barbet	<i>Megalaima viridis</i>	F	R	E	LC	IV	+	+	+			+	+	+	+	+
87	Rhipiduridae	White-throated fantail	<i>Rhipidura albicollis</i>	I	R		LC	IV	+	+	+			+	+	+		+
88	Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>	O	W		LC	IV									+	
89	Strigidae	Brown Fish-Owl	<i>Ketupa Zeylonensis</i>	C	R		LC	IV	+	+	+				+		+	+
90		Spotted Owlet	<i>Athene brama</i>	C	R		LC	IV	+	+					+	+	+	+
91	Sturnidae	Brahminy Starling	<i>Sturnia pagodarum</i>	O	R	E	LC	IV	+	+	+	+	+	+	+	+	+	+
92		Common Myna	<i>Acridotheres tristis</i>	O	R		LC	IV			+	+	+	+	+			+
93		Jungle Myna	<i>Acridotheres fuscus</i>	O	R		LC	IV	+	+	+				+	+		+
94	Sylviidae	Yellow Eyed Babbler	<i>Chrysomma sinense</i>	O	W		LC	IV	+	+	+		+		+			+
95	Timaliidae	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	I	R	E	LC	IV	+						+			
96	Turdidae	Indian Blackbird	<i>Turdus simillimus</i>	O	R	E	LC	IV	+	+	+				+	+		+
Total number of species									68	52	57	44	29	42	55	36	37	66

**Feeding Guild:** C: Carnivores, I: Insectivores, F: Frugivores, O: Omnivores, G: Granivores, P: Piscivores, N: Nectarivores **Migration Status:** R: Resident, W: Winter visitors, V: Vagrant **Endemism:** E: Endemic **IUCN Status:** NE: Not Evaluated, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CE: Critically Endangered

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	Hystriidae	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-VAR. Among mammals, Wild Boars created

level 4 nuisance to the paddy fields, whereas Leopard nuisance as predating 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	Hesperiidae	Asian Grizzled Skipper	<i>Spialia galba F.</i>		NE		+						+			
9	Lycaenidae	Common Cerulean	<i>Jamides celeno C.</i>		NE		+	+	+	+	+				+	+
10		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	<i>Papilio polymnestor</i> C.		NE		+	+	+	+	+	+	+			
30	e	Common Blue Bottle	<i>Graphium sarpedon</i> L.		LC			+	+				+			
31		Common Mormon	<i>Papilio polytes</i> L.		NE		+	+	+		+	+	+			
32		Crimson Rose	<i>Pachliopta hector</i> L.	E	LC	I	+	+	+	+	+	+	+			
33		Red Helen	<i>Papilio helenus</i> L.		LC		+	+	+	+	+		+			
34	Pieridae	Common Emigrant	<i>Catopsilia pomona</i> F.		NE		+	+	+	+	+	+	+			
35		Common grass yellow	<i>Eurema hecabe</i> L.		LC		+	+	+	+	+	+	+			
36		Common Jezebel	<i>Delias eucharis</i> D.		NE		+	+	+	+	+	+	+			
37		Common Wanderer	<i>Pareronia valeria</i> C.		NE			+		+			+			
38		Three spot grass yellow	<i>Eurema blanda</i> B.		NE		+	+	+	+	+	+	+			
39		White Orange Tip	<i>Ixias marianne</i> C.		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	Bufonidae	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						9	9	5	7	7	2	9	7	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

No. of species per acre				
Study site	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

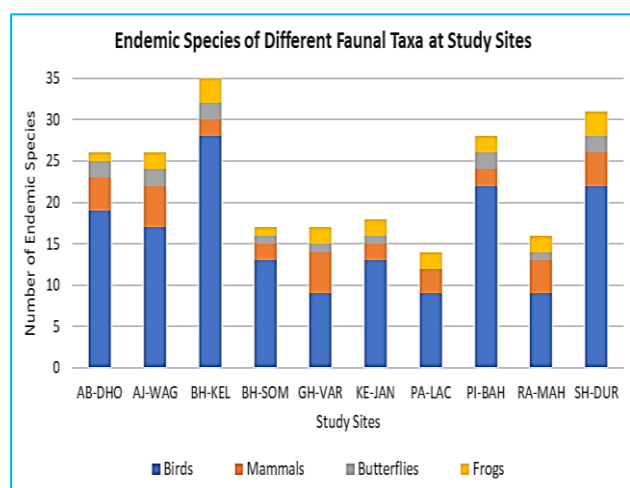


Fig 2 Endemic faunal species at the study sites

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].

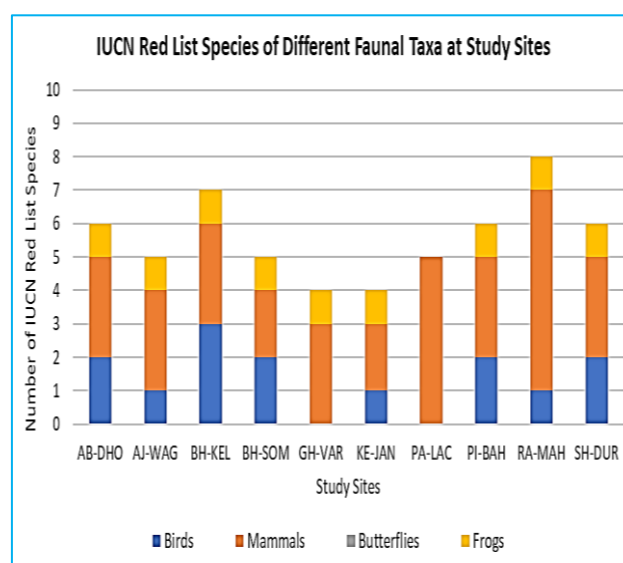


Fig 3 IUCN red listed faunal species at the study sites

## 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.

#### Acknowledgements

Authors are thankful to Dr. Ankur Patwardhan and Forest Department (MS) Pune, Bhore and Junnar Divisions for their support.

### LITERATURE CITED

1. Wild R, McLeod C. 2008. *Sacred Natural Sites: Guidelines for Protected Area Managers*. International Union for Conservation of Nature and Natural Resources.
2. Gadgil M, Vartak VD. 1976. The sacred groves of Western Ghats in India. *Economic Botany* 30: 152-160. doi: <https://doi.org/10.1007/BF02862961>.
3. Verschuuren B, Wild R, McNeely J, Oviedo G. 2010. *Sacred Natural Sites: Conserving Nature and Culture*. Earthscan.
4. Ormsby AA, Bhagwat SA. 2010. Sacred forests of India: A strong tradition of community-based natural resource management. *Environ. Conservation* 37(3): 320-326. doi:10.1017/S0376892910000561
5. Mahabaleshwarkar M, Ghayal N, Mahabaleshwarkar S. 2023. Phytosociological and ethnobotanical aspects of selected sacred groves in different agroclimatic zones of Pune district, India. *Res. Jr. Agric. Sciences* 14(2): 475-480.
6. Trivedi S, Bharucha E, Mungikar R. 2018. Rapid assessment of sacred groves: A biodiversity assessment tool for ground level practitioners. *Jr. Threat Taxa*. 10(2): 11262-11270.
7. Singh NP, Karthikeyan S. 2000. *Flora of Maharashtra State (Dicotyledones)*. Vol 1. Botanical Survey of India.
8. Plumptre A, Cox D. 2006. Counting primates for conservation: Primate surveys in Uganda. *Primates Jr. Primatol.* 47: 65-73. doi:10.1007/s10329-005-0146-8
9. Ali S. 2002. *The Book of Indian Birds*. 13<sup>th</sup> Edition. Oxford University Press, Bombay.
10. Grimmet R, Inskipp C, Inskipp T. 2014. *Birds of the Indian Subcontinent*. Digital Edition. Christopher Helm, an imprint of Bloomsbury Publishing.
11. Gururaja KV. 2012. *Pictorial Guide to Frogs and Toads of the Western Ghats*. Gubbi Labs LLP.
12. Kunte K. 2006. *India - A Life scape, Butterflies of Peninsular India*. 2<sup>nd</sup> Edition (Gadgil M). University Press (India) Pvt. Ltd.
13. Menon V. 2003. *A Field Guide to Indian Mammals*. 1<sup>st</sup> Edition (Eds) Daniel JC, Johnsingh AJT, Kumar A, Nameer PO, Choudhury A). Dorling Kindersley (India) Pvt. Ltd.
14. The IUCN Red List of Threatened Species <https://www.iucnredlist.org/en>. Published 2022. Accessed January 15, 2023. <https://www.iucnredlist.org/en>
15. Anonymous. 1972. *The Wild Life (Protection) Act, 1972*. Ministry of Environment and Forests, Government of India, New Delhi. pp 34.
16. Maharashtra State Symbols [http://www.bnhsevis.nic.in/Database/Maharashtra-State-Symbols\\_17587.aspx](http://www.bnhsevis.nic.in/Database/Maharashtra-State-Symbols_17587.aspx). Maharashtra State Symbols. Accessed April 21, 2023. [http://www.bnhsevis.nic.in/Database/Maharashtra-State-Symbols\\_17587.aspx](http://www.bnhsevis.nic.in/Database/Maharashtra-State-Symbols_17587.aspx)
17. Brown RL, Jacobs LA, Peet RK. 2007. Species richness: Small scale. In: John Wiley & Sons, Ltd, ed. *Encyclopaedia of Life Sciences*. 1<sup>st</sup> Edition. John Wiley & Sons, Ltd; 2007. doi:10.1002/9780470015902.a0020488
18. Nameer PO, Molur S, Walker S. 2001. Mammals of Western Ghats: A simplistic overview. *Zoos Print Jr. Rev.* 16(11): 629-639. doi:10.11609/JoTT.ZPJ.16.11.629-39
19. Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853-858. doi:10.1038/35002501
20. Jones J, Nowak R, Paradiso J. 1984. Walker's Mammals of The World. *Jr. Mammal.* 65: 171. doi:10.2307/1381225
21. Borges R. 2008. A nutritional analysis of foraging in the Malabar giant squirrel (*Ratufa indica*). *Biol. Jr. Linn. Society* 47: 1-21. doi:10.1111/j.1095-8312.1992.tb00652.x
22. Gadgil M, Berkes F. 1991. Traditional resource management systems. *Resource Management Optim.* 8(3/4): 127-141.
23. Mahabaleshwarkar M, Ghayal N. 2020. Need for integrated strategies for conservation and management of sacred groves: an overview from Pune District (MS, India). In: *Perspectives on Biodiversity of India - Proceedings of International Biodiversity Congress (IBC2018)*. Vol IV. CISSA; 2020: 449-451.