Journal of Threatened Taxa | www.threatenedtaxa.org | 26 April 2014 | 6(4): 5593–5612

Plant species composition on two rock outcrops from the northern Western Ghats, Maharashtra, India

Savita S. Rahangdale [1] & Sanjaykumar R. Rahangdale [2]

[1] Hon. B.J. Arts, Commerce and Science College, Ale, Junnar Taluk, Pune District, Maharashtra 412411, India
[2] PDEA's A. W. College of Science, Arts and Commerce, Otur, Junnar Taluk, Pune District, Maharashtra 412409, India
[1] gauriyana@hotmail.com, [2] rsanjay2@hotmail.com (corresponding author)

ISSN
Online 0974–7907
Print 0974–7893

OPEN ACCESS

Abstract: The Western Ghats are full of high altitude plateaus/rock outcrops amidst mesic forests. Throughout the world, rock outcrops are isolated habitats and known for their uniqueness with respect to environmental variables and biodiversity and well known as centers of species endemism. In India such special habitats are geographically known but very less information is available about their floristic wealth. Available studies are occasional and limited to ecology. Due to a lack of appropriate information and errors in the study models of random sampling, important habitats may get misinterpreted and pose a threat to conservation. A comprehensive botanical study of two rock outcrops, Durgawadi Plateau (DP) and Naneghat Plateau (NP), on the escarpment of the northern Western Ghats revealed a very high within-site (360 taxa on DP and 249 taxa on NP) and between-site plant diversity totaling to 443 taxa of specific and infraspecific ranks. The individual outcrop areas are very small (2.8793km^2 and 0.7524km^2 respectively for DP and NP) but harbor a huge diversity of flowering plants. The commonly shared taxa are relatively low (37% of the taxa recorded) indicating that the two outcrops are floristically very distinct from each other. They are also distinct in terms of soil composition, though on the same crest line of Sahyadri and quite close to each other. The study emphasizes the need for micro-level inventories of smaller areas by taking intensive surveys for documentation of different aspects of the abiotic and biotic diversity as well as other environmental and anthropogenic variables.

Keyword: Angiosperm diversity, Durgawadi, floristic composition, microhabitats, Naneghat, plateaus, rock outcrops.

Abbreviations: EIA - Environmental impact assessment; DP - Durgawadi Plateau; NP - Naneghat Plateau; RO - Rock outcrop.

Marathi Abstract: सारांश: पश्चिम घाट जंगलांनी वेढलेल्या उंचीवरील खडकाळ पठार व उत्थित खडकाळ अधिवासांनी भरलेला आहे. संपूर्ण जगात उत्थित खडकाळ अधिवास हे त्यांच्या वैशिष्ट्यपुर्ण परिस्थितीकीय परिमाणांसोबतच जैवविविधता व स्थानिक प्रजातींसाठी प्रसिद्ध आहेत. भारतात मुद्धा असे वैशिष्ट्यपुर्ण अधिवास भौगोलीकदृष्ट्या माहित आहेत. पण त्यांच्यावरील वानसशास्त्रीय माहितीचा वव्हंशी अभाव आहे. माहितीचा अभाव व स्वैर नमुना अभ्यास पद्धतीतील त्रृटींमुळे महत्वाच्या व वैविध्यपुर्ण स्थानावद्दल गैरसमज होऊन संवर्धन कार्यास धोका होऊ शकतो. सहयाद्रीच्या कडयांवरील दोन उत्थित खडकाळ अधिवास अनुक्रमे. दूर्गावाडी पठार व नाणेघाट पठार यांच्या सखोल वानसशास्त्रीय अभ्यासातून असे दिसून आले की दोन्हीवर मिळून एकूण ४४३ प्रकारच्या वनस्पती हया अधिवासात आहेत (दूर्गावाडी पठारावरील ३६० व नाणेघाट पठारावरील २४९). खरेतर दोन्ही स्थानांचे क्षेत्रफळ फार छोटे आहे (दूर्गावाडी २.८७९३ वर्ग किमी व नाणेघाट ०.७५२४ वर्ग किमी); पण त्यावरील सपुष्प वनस्पतींची विविधता मोठी आहे. दोन्ही स्थाने भौगोलीकदृष्ट्या जवळजवळ व सहयाद्रीच्या एकाच रांगेत असूनसुद्धा त्यातील वनस्पती साधर्म्य फक्त ३७ टक्के आहे म्हणजेच विविधतेच्या दृष्टीने एकमेकापासून भिन्न आहेत. सदर अभ्यासाद्वारे असे निदर्शनास येते की, परिस्थितीकीय व जैवविविधतेचा अभ्यास करतांना अतिशय सुक्ष्म स्तरांवरील बहुआयामी माहिती संकलन व अभ्यास करणे गरजेचे आहे.

DOI: http://dx.doi.org/10.11609/JoTT.o3616.5593-612

Editor: Aparna Watve, Pune, India. **Date of publication:** 26 April 2014 (online & print)

Manuscript details: Ms # o3616 | Received 07 May 2013 | Final received 09 April 2014 | Finally accepted 11 April 2014

Citation: Rahangdale, S.R. & S.R. Rahangdale (2014). Plant species composition on two rock outcrops from the northern Western Ghats, Maharashtra, India. *Journal of Threatened Taxa* 6(4): 5593–5612; http://dx.doi.org/10.11609/JoTT.o3616.5593-612

Funding: None.

Competing Interest: The authors declare no competing interests.

Author Contributions: SSR dealt with the taxonomic part along with the endemic taxa, while SRR has taken exhaustive field works and collection of the information for present study.

Author Details: Savita S. Rahangdale holds a PhD in angiosperm taxonomy, with special reference to impact of anthropocentric developmental activities on floristic composition, from Agharkar Research Institute, Pune and works as Assistant Professor in Botany. She is a Fellow of the Indian Association for Angiosperm Taxonomy (IAAT). Sanjaykumar R. Rahangdale holds a PhD in classical genetics from Agharkar Research Institute, Pune and works as Assistant Professor in Botany.

Acknowledgements: The authors sincerely acknowledge the constant support and help from Department of Forests, Government of Maharashtra, during field works; Dr. Aparna Watve for suggestions and technical support during the work on plateaus; Director and in-charge of Botanical Survey of India, Western Regional Centre, Pune and Agharkar Research Institute, Pune for permission to refer the herbaria for confirmation of doubtful specimens; and Principals of B.J. College, Ale and A.W. College, Otur for facilities.

INTRODUCTION

Rock outcrops are well known throughout the world but less studied. Most of the studies are from African, American and Australian outcrops (Porembski et al. 1994, 2000; Burke 2005 a,b; Jacobi et al. 2007) describing the habitat types and associated vegetation composition. In India, relatively very few reports exist about vegetation on these special habitats (Porembski & Watve 2005; Watve 2008, 2013; Lekhak & Yadav 2012; Bhattarai et al. 2012). High altitude rock outcrops are found throughout the Western Ghats in India. Rock outcrops are naturally occurring landforms where open rock surface is visible over a large area that has very little soil or only pockets of deep soil. The rock outcrops in the Western Ghats are of two types based on the rock formation and soil type developed from it: (i) Lateritic—lateritic rock cover is well preserved over the parent basalt rock and soil rich in iron e.g., Kas Plateau and other low altitude plateaus in the Konkan region and (ii) Basaltic—having black hard rock and soil, e.g., plateaus with forts, such as Naneghat Plateau. Some plateaus in the northwestern corner of Pune District are entirely basaltic but have some lateritic soil due to weathering. Such rock outcrops have a distinct geographical feature, of a little porous rock and yellowish-gravelly soil. They have a diversity of micro-habitats and are rich in flora and fauna. Trees or shrubs are less in number, but herbaceous angiosperms, algae, mosses, ferns and lichens are generally abundant in these habitats. Many of the endemic ephemerals, herbaceous angiosperms, pteridophytes and lichens are restricted to these special habitats. Species composition patterns and outcrop communities are influenced by multiple environmental factors like soil type, elevation, aspect of that rock outcrop and micro-environments. Transect studies of plateaus in the northern Western Ghats and Konkan region by Watve (2008, 2013) are confined to the vegetation composition and pattern of only some microhabitats on plateaus. Complete diversity on the plateaus in the northern Western Ghats is not yet revealed satisfactorily.

Though the rock outcrops are considered to be isolated from the surrounding landscape, they are always surrounded by some vegetation or ecological niches. These surrounding areas and biotypes on it are indispensable factors of any rock outcrop; because the biota from the surrounding area greatly influences the plateau biota as well as the ecological conditions on it.

The present study represents the total floristic diversity observed for the last 10 years on and around two important rock outcrop areas, the Durgawadi Plateau (DP) and the Naneghat Plateau (NP) in the northern Western Ghats. A comprehensive study with respect to total floristic diversity along with microhabitats is reported for the first time from these unique areas showing basaltic rock outcrops. The comparative account of the ecological and floristic aspects between them is discussed.

Study Area

Ghod Project Division, Junnar, Department of Forests, falls under district Pune, Maharashtra State, India. The area comprises of late creataceous to early tertiary high hill escarpment of Sahyadri (Ollier & Sheth 2008) on the West to north-west side. The undulating spurs of the escarpment spread on the east southward ending in plains and low altitude small basaltic outcrops. The escarpment receives the headwater during the monsoon months and the eastern plains are under the watershed. The forest types vary from moist semi-evergreen montane types with some evergreen patches within them on the hills and valleys to dry scrub forests on the east, through moist and dry deciduous forests. The forests are interspersed by many small rocky outcrops, of them 14 outcrops are identified in the Ghod Project division boundary. The present study describes floristic diversity on two significant outcrops among them (Images 1 & 2).

The Junnar Forest Division (JFD) (18^{0}27’51.48”–19^{0}24’03.6”N & 73^{0}31’18.84”–74°35’09.24”E) has a total geographic area of 4360km^2; of this about 12.5% area is under semi-evergreen to thorny scrub type of vegetation (reserved and unclassified forests). The annual rainfall varies from 2800mm on the west of the hilly sections to 240–600 mm on the eastern side slopes and plains.

Durgawadi Plateau

The Durgawadi Plateau (Image 3) is one of the largest and florally rich basalt outcrops in Pune District; located 30km from Junnar Town at the south-west corner in Junnar Taluka between 19^{0}11’37.99”N & 73^{0}41’42.57”E to 19^{0}13’3.59”N & 73^{0}38’33.92”E with an elevation that ranges from 1037–1156 m. This plateau spreads over an area of 2.8793km^2 out of a total geographic area of 16.28km^2 of village Ambe-Hatvij and its ‘wadis’, Pimparwadi and Durgawadi. RO area is mainly basalt with a few pockets of lateritic soil supporting small forest patches out of a total reserve forest area of 2.11km^2. Most of the areas of RO are private lands extensively cultivated for rice and ‘nachni’ (finger millet). There are four sacred groves on the plateau with a good broad leaved montane forest community of large trees

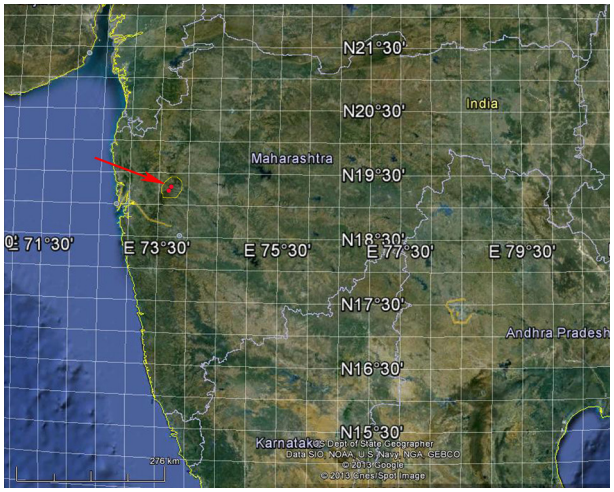

Image 1. Location of study area; two rock outcrops are demarcated by red spots near the tip of arrow.

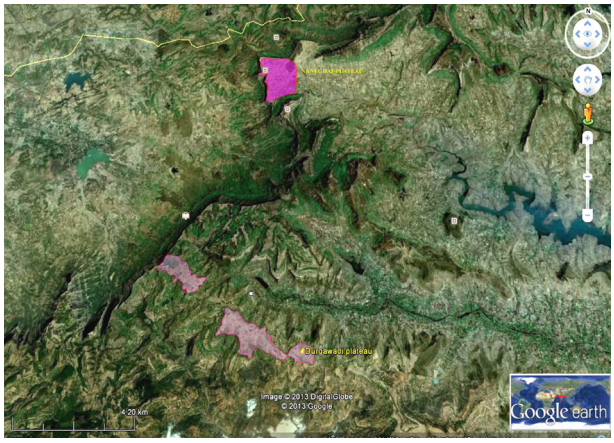

Image 2. The terrain map revealing topography of the Durgawadi and Naneghat plateaus under study.

comprising *Mangifera indica, Memecylon umbellatum, Xantolis tomentosa, Atalantia racemosa* and *Syzygium* species. The climate at Durgawadi Plateau is cool and humid with an average minimum and maximum temperature of 11^{0}C and 38^{0}C, respectively, and an average annual rainfall of 1500–2000 mm or even higher.

Botanical history of the Durgawadi Plateau

The Durgawadi Plateau is floristically very important because a number of new taxa are described from this region or associated region viz., *Ceropegia rollae* (Hemadri 1968a); *Chlorophytum bharuchae* Ansari et al. (1970); *Leucas deodikarii* Billore & Hemadri (1970); *Ischaemum raizadae* Hemadri & Billore (1970); *Isachne borii* Hemadri (1971a); *Alysicarpus vasavadae* and *Smithia agharkarii* Hemadri (1971b); *Bothriochola jainii* Deshpande & Hemadri (1971); *Ceropegia mahabalei* Hemadri & Ansari (1971); *Arthraxon junnerensis* Jain & Hemadri (1971). Hemadri (1968b) also reported some new records for Maharashtra State from the study area, viz., *Cucumis setosus* and *Blyxa aubertii;* similarly Rahangdale et al. (2009) reported *Garnotia courtallensis* as a new record for Maharashtra. Recent plant descriptions from the study area are *Jansenella neglecta* Yadav et al. (2010); *Ceropegia mahabalei* var. *hemlatae* Rahangdale & Rahangdale (2012) and *Mucuna sanjappae* Aitawade & Yadav (2012). All new taxa described from the location are endemic.

Naneghat Plateau

Naneghat is a famous historical and archaeological place near Ghatghar Village (19^{0}16'45.63"N & 73^{0}41'19.96"E to 19^{0}17'53.29"N & 73^{0}40'26.37"E) located 36km away from Junnar as an ancient mountain pass, from the period of Satvahan kings (approximately 700 A.D.). This plateau spreads over an area of 0.7524km^2 out of 10.97km^2 total geographic area of Ghatghar Village (Image 4). Most of the area is under private ownership, while the mountain pass and surrounding areas are under reserve forests (3.2518km^2). The highest point is about 750m. The hill fort 'Jeevdhan' on this plain area rises steeply to 900m. The basalt is exposed as a broad expanse at a low altitude and bounded by sacred groves, reserve forest patches, rice fields and vertical slopes. The outcrop and its surroundings are affected by biotic pressures. There are two sacred groves on the plateau comprising *Terminalia chebula*, *Meyna laxiflora, Heterophragma quadriloculare, Flacourtia* sp., *Xantolis tomentosa, Bambusa* sp. and *Sterculia* sp. Floristically this area is rich in diversity, Hemadri (1970) and Rahangdale (2009) explored this region for floristic diversity, while ephemeral plant communities on the outcrops were studied by Watve (2008, 2013).

Micro habitats on study areas

Plant communities on these ROs are associated with different microhabitats. According to the microhabitats, the biota is different on these ROs. Each microhabitat has characteristic features with respect to soil, water and species composition. The microhabitats are classified into rock surfaces, boulders, rock crevices, ephemeral pools, soil-filled depressions and ephemeral flush vegetation (Watve 2008, 2013). In the present study, 11 microhabitats are observed on ROs and mentioned in the results. The sacred groves, tree cover on plateaus and surrounding slope vegetation are also an integral part of a RO as their influence on it is indispensable and therefore such vegetations are also considered while

Image 3. Durgawadi rock outcrop along with the fortress in the background

Image 4. Basaltic rock outcrop of Naneghat along with Jivdhan fortress in the background

taking floristic diversity into account.

METHODS

Data Collection

Extensive and repeated field surveys were carried out from 1999 to 2012 at both the locations to cover all the seasons of the year. A comprehensive list of plants has been prepared for each location so as to get the range of distribution, ecological variations and frequency of particular species in the area under study. Occurrence of the taxa is recorded on the visual observations during field work in the study area and the taxa are grouped in four categories of occurrence. Common (C)—when the taxon occurs in all the habitats and population size is large; Frequent (F)—the taxon occurs in most of the habitats but with relatively smaller population than common; Occasional (O)—taxon occurs in a few habitats and population is also small; Rare (R)—the taxon is restricted to very specific habitats and population is of a few individuals. During field surveys emphasis was given to documenting the type of vegetation, habit, habitat, phenology and associated species. Monsoon ephemerals, tuberous, cormatous and rhizomatous plants with a short life span were given special attention to get data on their life cycle and phenology. Morphological characters were recorded on the basis of fresh material in the field.

Laboratory Studies

Collected plant specimens were processed for the herbarium following standard techniques (Jain & Rao 1977). In most of the cases the specimens were identified afresh. All the herbarium specimens were carefully checked in the laboratory and their identity was confirmed with help of the floras (Dalzell & Gibson 1861; Hooker 1872–1897; Cooke 1901–1908 (Rep.1958); Santapau 1957, 1960; Hemadri 1970; Matthew 1982; Sharma et al. 1996; Singh & Karthikeyan 2000; Singh et al. 2001; Almeida 1996, 1998, 2001, 2003, 2009); relevant monographs (Blatter & McCann 1935; Santapau & Kapadia 1966; Hemadri 1980; Ansari & Balakrishnan 1994); fascicles (Ansari 1984) and published literature in scientific journals. Doubtful specimens were checked and confirmed by comparing with earlier identified specimens at the following herbaria: (i) Botanical Survey of India, Western Circle, (BSI), Pune, (ii) Agharkar Herbarium (AHMA), Agharkar Research Institute, Pune.

Any deviation from earlier descriptions or authentic herbarium specimens are recorded and duly documented as a critical note. The voucher specimens are deposited in the Herbarium of Balsaheb Jadhav College, Ale. The plant names have been checked by using online database of IPNI (2013). The status of the taxa (Table 1) was assigned at the level of BSI on the basis of Ahmedullah & Nayar (1987); Nayar & Sastry (1987–89); Mishra & Singh (2001) and at IUCN level on the basis of the information available on www.iucnredlist.org (accessed on 22 April 2014).

RESULTS AND DISCUSSION

The observations about the rock outcrops and vegetation are subdivided into the following heads.

Habitats

Durgawadi and Naneghat are quite adjacent to each other with an aerial distance of 5km between the two study areas, while the farthest distance is about 10.5km

Table 1. Species list from two outcrops, Durgawadi Plateau (DP) and Naneghat Plateau (NP).

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
1	Acanthaceae	*Asystasia dalzelliana* Sant.	CE, RC, SG	F	F	DD	
2	Acanthaceae	*Blepharis maderaspatensis* B. Heyne ex Roth	ERS, RC	Nil	O		
3	Acanthaceae	*Carvia callosa* (Nees) Bremek.	B, SG, SCA	C	O	DD	
4	Acanthaceae	*Haplanthodes verticillatus* (Roxb.) R.B.Majumdar	SP, RC	F	F	DD	
5	Acanthaceae	*Hygrophila sculli* (Buch.-Ham.) M.R. & S.M. Almeida	SP, RC, SEP	O	R		
6	Acanthaceae	*Hygrophila serpyllum* T. Anderson	SP, RC, SEP	F	Nil		
7	Acanthaceae	*Justicia betonica* L.	SRA, SG	F	C		
8	Acanthaceae	*Nilgirianthus reticulatus* (Stapf) Bremek.	CE, SRA	R	Nil	LR	
9	Acanthaceae	*Rostellularia diffusa* (Nees.) Nees	CE	Nil	F		
10	Acanthaceae	*Thelepaepale ixiocephala* (Benth.) Bremek.	B, CE	O	Nil	DD	
11	Acanthaceae	*Thunbergia laevis* Wall. & Nees	SRA, SG	F	Nil		
12	Amaranthaceae	*Achyranthes coynei* Sant.	CE, RC	O	Nil	DD	
13	Amaranthaceae	*Aerva lanata* (L.) Schult.	SG	O	R		
14	Amaranthaceae	*Celosia argentea* L.	B, CE	C	R		
15	Anacardiaceae	*Mangifera indica* L.	SG	F	R		
16	Apiaceae	*Heracleum grande* (Dalz. & Gibs.) P.K.Mukh.	B, CE, RC, SFD	O	R	LR	
17	Apiaceae	*Pimpinella adscendens* Dalzell	RC, CE	O	O	LR	
18	Apiaceae	*Pimpinella tomentosa* Dalzell ex C.B.Cl.	CE, SG	O	Nil	LR	
19	Apiaceae	*Pimpinella wallichiana* (Miq.) Gandhi	SG	R	Nil	DD	
20	Apiaceae	*Pinda concanensis* (Dalzell) P.K.Mukh. & Constance	SFD, SCA	R	Nil	LR	
21	Apiaceae	*Trachyspermum ammi* Sprague	SFA, CE	C	Nil	DD	
22	Apocynaceae	*Carissa congesta* Wight	SG	F	R		
23	Apocynaceae	*Catharanthus pusillus* (Murr.) G.Don	ERS,SRA	Nil	O		
24	Apocynaceae	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G.Don	PTC, SG	Nil	O		LC
25	Apocynaceae	*Plumeria acutifolia* Poir.	SG	Nil	R		
26	Apocynaceae	*Wrightia tincoria* R.Br.	SG	O	R		
27	Asclepiadaceae	*Ceropegia bulbosa* Roxb.	RC, ERS	Nil	O	LR	
28	Asclepiadaceae	*Ceropegia media* (Huber) Ansari	RC, SFA	R	R	VU	
29	Asclepiadaceae	*Ceropegia rollae* Hemadri	RC, SFD	R	R	CR	
30	Asclepiadaceae	*Gymnema sylvestre* (Retz.) R.Br. ex Schultes	SG	Nil	O		
31	Asclepiadaceae	*Hemidesmus indicus* (L.) R.Br.	RC, SRA, SG	O	F		
32	Asclepiadaceae	*Hoya wightii* Hook.f.	SG	O	Nil		
33	Asclepiadaceae	*Seshagiria sahyadrica* Ansari & Hemadri	ERS, SG	F	Nil	VU	
34	Asclepiadaceae	*Tylophora dalzellii* Hook.f.	SRA, SG	F	O		
35	Asclepiadaceae	*Tylophora indica* Merr.	CE, SG	F	F		
36	Asclepiadaceae	*Wattakaka volubilis* (L.f.) Stapf.	SRA, SG	Nil	R		
37	Asteraceae	*Acanthospermum hispidum* DC.	CE	Nil	F		
38	Asteraceae	*Ageratum conyzoides* L.	SG	Nil	O		
39	Asteraceae	*Artemisia nilagirica* (C.B.Cl.) Pamp.	SG	C	Nil		
40	Asteraceae	*Bidens biternata* (Lour.) Merr. & Sherff.	ERS	Nil	O		
41	Asteraceae	*Blumea obliqua* (L.) Druce	ERS, SRA	Nil	O		
42	Asteraceae	*Blumea malcolmii* Hook.f.	CE, RC	C	C	DD	
43	Asteraceae	*Blumea venkataramanii* R.S.Rao & Hemadri	ERS	R	Nil	EN	

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
44	Asteraceae	*Caesulia steroids* Roxb.	SEP	Nil	F		LC
45	Asteraceae	*Conyza aegyptiaca* (L.) Aiton	CE, RC	C	Nil		
46	Asteraceae	*Cosmos bipinnatus* Cav.	ERS	O	√		
47	Asteraceae	*Cyathocline lutea* Law ex Wight	SEP, SCA	C	Nil	EN	LC
48	Asteraceae	*Cyathocline purpurea* Kuntze	SEP, SCA, SFD	C	F	VU	LC
49	Asteraceae	*Eclipta prostrata* (L.) L.	CE, SG	O	O		
50	Asteraceae	*Elephantopus scaber* L	SG	Nil	O		
51	Asteraceae	*Emilia sonchifolia* (L.) DC.	SFD	Nil	F		
52	Asteraceae	*Eupatorium odoratum* L.	SCA	R	O		
53	Asteraceae	*Glossocardia bosvallea* (L.f.) DC.	ERS	Nil	C		
54	Asteraceae	*Gynura bicolor* (Roxb. ex Willd.) DC.	SFD, CE	Nil	O		
55	Asteraceae	*Helichrysum luteoalbum* (L.) Richb.	ERS, SEP	F	F		
56	Asteraceae	*Kleinia grandiflora* (Wall. ex DC.) N.Rani	SG	O	Nil		
57	Asteraceae	*Lagasca mollis* Cav.	CE	Nil	R		
58	Asteraceae	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	RC, SFD	Nil	O		
59	Asteraceae	*Nanothamnus sericeus* Thomson	ERS	F	Nil	EN	
60	Asteraceae	*Senecio bombayensis* N.P.Balakr.	CE, RC, SFD	F	O		
61	Asteraceae	*Senecio dalzellii* C.B.Cl.	SCA, SEP	C	Nil	DD	
62	Asteraceae	*Senecio hewrensis* Hook.f.	CE	C	Nil	DD	
63	Asteraceae	*Sphaeranthus indicus* L	SCA	Nil	O		LC
64	Asteraceae	*Spilanthus calva* DC.	SCA, SEP	C	Nil		
65	Asteraceae	*Spilanthus paniculata* Wall. *ex* DC.	SRA	C	F		
66	Asteraceae	*Tricholepis amplexicaulis* C.B. Cl.	SFD	F	Nil	DD	
67	Asteraceae	*Tricholepis radicans* DC.	SRA	F	F	DD	
68	Asteraceae	*Tridax procumbens* L.	SCA	F	O		
69	Asteraceae	*Vernonia divergens* (Roxb.) Edgew.	SRA	Nil	F		
70	Asteraceae	*Xanthium indicum* Koen.	SRA	Nil	R		
71	Asteraceae	*Zinnia elegans* Jacq.	SCA	Nil	F		
72	Balsaminaceae	*Impatiens dalzellii* Hook.f. & Thomson	RC, SFD	O	Nil	DD	
73	Balsaminaceae	*Impatiens lawii* Hook.f. & Thomson	SG, SFD, RC	O	Nil	DD	
74	Balsaminaceae	*Impatiens minor* (DC.) Bennet	RC, SG	O	Nil	DD	
75	Balsaminaceae	*Impatiens oppositifolia* L.	SFD, SG	O	O		
76	Balsaminaceae	*Impatiens balsamina* L.	SRA, SFD	F	O		
77	Begoniaceae	*Begonia crenata* Dryand.	CE, B	C	R	DD	
78	Bignoniaceae	*Radermachera xylocarpa* K.Schum.	SG	R	Nil		
79	Bignoniaceae	*Heterophragma quadriloculare* (Roxb.) K.Schum.	SG	Nil	O		
80	Boraginaceae	*Cordia macleodii* Hook.f. & Thomson	SG	O	R		
81	Boraginaceae	*Cynoglossum amabile* Stapf & J.R.Drumm.	SCA	F	O		
82	Boraginaceae	*Heliotropium indicum* L.	SRA	Nil	R		
83	Boraginaceae	*Heliotropium supinum* L.	SRA	Nil	F		
84	Brassicaceae	*Rorippa indica* (L.) Hiern.	SCA	F	O		
85	Buddlejaceae	*Buddleja asiatica* Lour	PTC	R	Nil		
86	Caesalpinaceae	*Bauhinia racemosa* Lam.	SG	Nil	R		
87	Caesalpiniaceae	*Cassia fistula* L.	SG	O	O		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
88	Campanulaceae	*Lobelia nicotianifolia* Roth ex Schult.	SRA, SFD	O	Nil		
89	Capparaceae	*Capparis rotundifolia* Rottler	SG	R	Nil		
90	Capparaceae	*Cleome simplicifolia* (Cambess.) Hook.f. & Thomson	ERS	F	C	DD	
91	Caryophyllaceae	*Polycarpon prostratum* (Forssk.) Asch. & Schweinf.	ERS, CE	F	F		
92	Celastraceae	*Celastrus paniculatus* Willd.	SG	Nil	O		
93	Celastraceae	*Maytenus senegalensis* (Lam.) Excell	SG	O	F		
94	Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.	SG	O	O		
95	Combretaceae	*Terminalia chebula* Retz.	SG	F	O		
96	Combretaceae	*Terminalia elliptica* Willd.	SG	F	Nil		
97	Convolvulaceae	*Argyreia cuneata* Ker Gawl.	SG	O	Nil	DD	
98	Convolvulaceae	*Argyreia sericea* Dalzell	SG	F	R	DD	
99	Convolvulaceae	*Evolvulus alsinoides* L.	ERS, SCA	Nil	C		
100	Convolvulaceae	*Merremia gangetica* (L.) Cufod	SG	O	Nil		LC
101	Convolvulaceae	*Porana racemosa* Roxb.	SG	O	Nil		
102	Convolvulaceae	*Rivea hypocrateriformis* (Desr.) Choisy	SG, SRA	Nil	O		
103	Convolvulaceae	*Rivea laotica* Ooststr.	SRA	F	Nil		
104	Crassulaceae	*Kalanchoe olivacea* Dalzell	RC, SFD	O	R	DD	
105	Cucurbitaceae	*Cucumis melo* L.	SRA	O	Nil		
106	Cucurbitaceae	*Cucumis setosus* Cogn.	SCA	O	Nil	DD	
107	Cucurbitaceae	*Dicaelospermum ritchei* C.B.Cl.	SCA	O	Nil	DD	
108	Cucurbitaceae	*Momordica dioica* Wall.	RC, SFD	O	O		
109	Cucurbitaceae	*Mukia madraspatana* (L.) Roem.	SG	Nil	O		
110	Cucurbitaceae	*Solena amplexicaulis* (Lam.) Gandhi	SG	Nil	O		
111	Droseraceae	*Drosera indica* L.	SCA, SEP	F	Nil		LC
112	Ebenaceae	*Diospyros exsculpta* Buch.-Ham.	PTC, SG	R	Nil		
113	Ebenaceae	*Diospyros montana* B. Heyne ex A.DC.	PTC, SG	O	O		
114	Elaeagnaceae	*Elaeagnus conferta* Roxb.	SG	F	Nil		
115	Euphorbiaceae	*Breynia retusa* (Dennst.) Alston	SG	O	Nil		
116	Euphorbiaceae	*Bridelia retusa* Spreng.	PTC, SG	O	R		
117	Euphorbiaceae	*Euphorbia fusiformis* Buch-Ham. ex D.Don	SRA	F	Nil		
118	Euphorbiaceae	*Euphorbia thymifolia* L.	ERS	Nil	O		
119	Euphorbiaceae	*Euphorbia hirta* L.	ERS	Nil	C		
120	Euphorbiaceae	*Euphorbia laeta* Roth	RC	C	Nil		
121	Euphorbiaceae	*Euphorbia ligularia* Roxb.	SG	O	Nil		
122	Euphorbiaceae	*Glochidion ellipticum* Wight	PTC, SG	F	Nil	DD	
123	Euphorbiaceae	*Mallotus philippensis* (Lam.) Mull. Arg.	SG	O	O		
124	Euphorbiaceae	*Phyllanthus fraternus* G.L. Webster	SRA, SFD	F	Nil		
125	Euphorbiaceae	*Sepium insigne* Benth. & Hook.f.	SG	O	O		
126	Fabaceae	*Alysicarpus belgaumensis* Wight	SRA	F	Nil	DD	
127	Fabaceae	*Alysicarpus pubescens* Law	SRA	O	Nil	DD	
128	Fabaceae	*Cajaus lineatus* Graham	SFD, SRA	O	Nil	DD	
129	Fabaceae	*Cajanus sericeus* (Benth. *ex* Baker) Maesen	SRA	F	Nil	DD	
130	Fabaceae	*Crotolaria juncea* L.	SRA	F	O		
131	Fabaceae	*Crotalaria filipes* Benth.	SCA	C	F	DD	

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
132	Fabaceae	*Crotalaria leptostachya* Benth.	SRA	R	Nil	DD	
133	Fabaceae	*Desmodium alysicarpoides* Meeuwen	SCA	F	Nil		
134	Fabaceae	*Desmodium gangeticum* (L.) DC.	SRA, SG	O	Nil		
135	Fabaceae	*Desmodium ritchiei* Sanjappa	SCA	C	O	DD	
136	Fabaceae	*Flemingia strobilifera* (L.) W.T. Aiton. var. *bracteata* (Roxb.) Baker	SRA, SG	O	O		
137	Fabaceae	*Geissaspis cristata* Wight & Arn	SCA, SEP, SFD, RC	Nil	C		LC
138	Fabaceae	*Geissaspis tenella* Benth.	SCA, SEP	C	C	DD	LC
139	Fabaceae	*Mucuna sanjappae* Aitawade & Yadav	SRA	R	Nil	DD	
140	Fabaceae	*Mucuna pruriens* (L.) DC.	SRA, SG	O	Nil		
141	Fabaceae	*Smithia conferta* J.E.Sm.	SRA	C	Nil		
142	Fabaceae	*Smithia agharkarii* Hemadri	SCA	O	R	VU	
143	Fabaceae	*Smithia bigemina* Dalzell	SCA, SFD, RC	F	F	DD	
144	Fabaceae	*Smithia capitata* Desv.	SCA	C	F	DD	
145	Fabaceae	*Smithia hirsuta* Dalzell	SCA	O	O	DD	LC
146	Fabaceae	*Smithia purpurea* Hook.	SRA, SEP, RC, SFD	C	F	DD	
147	Fabaceae	*Smithia racemosa* B.Heyne	SRA	F	Nil		
148	Fabaceae	*Smithia sensitiva* Aiton	SRA	C	R		LC
149	Fabaceae	*Smithia setulosa* Dalzell	SRA, SFD	C	Nil	DD	
150	Fabaceae	*Sphenostylis bracteata* (Bakerf.) J.B.Gillett	SRA	O	Nil	VU	
151	Fabaceae	*Vigna khandalensis* (Sant.) Raghavan & Wadhwa	SG, SRA	Nil	R	VU	NT
152	Fabaceae	*Vigna vexillata* (L.) A.Rich	SFD, RC, SCA	F	O	DD	
153	Fabaceae	*Zornia diphylla* (L.) Pers.	ERS	F	F		
154	Flacourtiaceae	*Flacourtia indica* (Burm.f.) Merr.	PTC, SG	O	Nil		
155	Flacourtiaceae	*Flacourtia latifolia* T. Cooke	PTC, SG	O	R	DD	
156	Gentianaceae	*Canscora diffusa* R.Br.	CE, RC	C	F		
157	Gentianaceae	*Canscora pauciflora* Dalz.	SRA	R	Nil	DD	
158	Gentianaceae	*Centaurium meyeri* Druce	RC, SCA, SFD	F	O		
159	Gentianaceae	*Enicostema axillare* (Lam.) Raynal	SRA	Nil	F		
160	Gentianaceae	*Exacum lawii* C.B.Cl.	SCA, SFD	C	Nil	DD	
161	Gentianaceae	*Hoppea dichotoma* Heyne ex Willd.	ERS	Nil	F		LC
162	Gentianaceae	*Swertia densifolia* (Griseb.) Kashyapa	SRA, SFD	O	Nil	DD	
163	Gentianaceae	*Swertia lawii* Burkill	SCA	F	Nil	DD	
164	Gentianaceae	*Swertia minor* Knobl.	SCA, SEP	F	R	DD	
165	Lamiaceae	*Anisomeles indica* (L.) O.Ktze.	CE	C	O		
166	Lamiaceae	*Colebrookea oppositifolia* Sm.	SRA, SG	Nil	O		
167	Lamiaceae	*Isodon lophanthoides* (Buch.-Ham. ex D.Don) H.Hara	SRA	O	Nil		
168	Lamiaceae	*Lantana camara* L.	SCA, SG	C	Nil		
169	Lamiaceae	*Lavandula bipinnata* Kuntze	ERS	C	F		
170	Lamiaceae	*Leucas biflora* Benth.	ERS, SCA	O	Nil		
171	Lamiaceae	*Leucas cephalotes* (Roth) Spreng.	SG	R	Nil		
172	Lamiaceae	*Leucas ciliata* Hochst. ex Benth.	SG	C	Nil		
173	Lamiaceae	*Leucas deodikarii* Billore & Hemadri	SG	O	Nil	EN	
174	Lamiaceae	*Leucas indica* R.Br.	SG	C	O		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
175	Lamiaceae	*Pogostemon plectrantoides* Desf.	SRA, SG	F	Nil		
176	Lamiaceae	*Pogostemon stellatus* (Lour.) Kuntze	SRA, SG	C	Nil		LC
177	Lauraceae	*Actinodaphne angustifolia* Hook.f. & Thomson ex Meisn.	SG	F	Nil	DD	
178	Lecythidaceae	*Careya arborea* Roxb.	SG	R	Nil		
179	Leeaceae	*Leea indica* (Burm.f.) Merr.	SRA, SG	C	F		
180	Lentibulariaceae	*Utricularia striatula* J.E.Sm.	SP, SEP	F	O		LC
181	Lentibulariaceae	*Utricularia albocaerulea* Dalzell	SP, SEP, B	C	Nil	DD	VU
182	Lentibulariaceae	*Utricularia graminifolia* Vahl	SP, SEP	F	Nil		LC
183	Lentibulariaceae	*Utricularia purpurascens* J.Graham	SP, SEP, B, SFD	F	O	DD	
184	Linaceae	*Linum mysurense* B. Heyne ex Benth.	SCA	C	F	DD	
185	Loranthaceae	*Dendropthoe falcata* (L.f.) Ettingsh.	SG	C	R		
186	Lythraceae	*Ammannia baccifera* L. ssp. *baccifera*	SP, SEP, SFD	Nil	F		LC
187	Lythraceae	*Ammannia multiflora* Roxb.	SP, SEP	C	Nil		
188	Lythraceae	*Lagerstroemia microcarpa* Wight	SG	Nil	O	DD	
189	Lythraceae	*Rotala densiflora* Koehne	SP, SEP	C	Nil		LC
190	Lythraceae	*Rotala macrandra* Koehne	SP, SEP	F	Nil		LC
191	Lythraceae	*Rotala occultiflora* Koehne	SP, SEP	F	Nil		LC
192	Malvaceae	*Abutilon indicum* (L.) Sweet.	SG	Nil	F		
193	Malvaceae	*Hibiscus caesius* Garcke	SG	F	Nil		
194	Malvaceae	*Kydia calycina* Roxb.	SG	F	Nil		
195	Malvaceae	*Malvastrum coromandelianum* (L.) Garcke.	SG	Nil	F		
196	Malvaceae	*Sida acuta* Burm.f.	SG, SRA	Nil	O		
197	Malvaceae	*Sida mysorensis* Wight & Arn.	SG	F	Nil		
198	Malvaceae	*Thespesia populnea* (L.) Correa	SG	R	Nil		
199	Malvaceae	*Urena lobata* L.	SG, SCA	F	O		
200	Melastomataceae	*Memecylon umbellatum* Burm.f.	SG	F	O		
201	Melastomataceae	*Sonerila scapigera* Dalzell	B, RC	F	O	DD	
202	Menispermaceae	*Cissampelos pareira* L.	SG	O	Nil		
203	Menispermaceae	*Stephania japonica* (Thunb.) Miers	SG	O	R	DD	
204	Menispermaceae	*Tinospora cordifolia* Miers.	SG	Nil	R		
205	Menispermaceae	*Tinospora sinensis* (Lour.) Merr.	SG	O	Nil		
206	Menyanthaceae	*Nymphoides indica* (L.) Kuntze	SP	O	Nil	DD	LC
207	Mimosaceae	*Albizia procera* (Roxb.) Benth.	SG	R	Nil		
208	Molluginaceae	*Glinus lotoides* L.	ERS, SCA	Nil	F		
209	Moraceae	*Artocarpus heterophyllus* Lam.	SG	Nil	R		
210	Moraceae	*Ficus racemosa* L.	SG	Nil	R		
211	Moraceae	*Ficus hispida* L.f.	SG, PTC	O	Nil		
212	Myrsinaceae	*Embelia basaal* (Roem. & Schult.) A.DC.	SG	O	O	DD	
213	Myrsinaceae	*Maesa indica* (Roxb.) Sweet	SG	O	Nil	DD	
214	Myrtaceae	*Syzygium cumini* (L.) Skeels	SG	F	Nil		
215	Oleaceae	*Jasminum malabaricum* Wight	SG	O	O	DD	
216	Oleaceae	*Olea dioica* Roxb.	SG, PTC	F	Nil		
217	Orobanchaceae	*Christisonia lawii* Wight	SG	R	Nil		
218	Oxalidaceae	*Biophytum sensitivum* (L.) DC.	SRA	R	O		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
219	Papaveraceae	*Argemone mexicana* L.	SCA, ERS	F	Nil		
220	Passifloraceae	*Passiflora foetida* L.	ERS, RC	Nil	O		
221	Periplocaceae	*Cryptolepis buchanani* Roem. & Schult.	SG	Nil	R		
222	Periplocaceae	*Hemidesmus indicus* (L.) Schult	SG	Nil	F		
223	Piperaceae	*Piper trichostachyon* (Miq.) C.DC.	SG	R	O	DD	
224	Plumbaginaceae	*Plumbago zeylanica* L.	SG	Nil	O		
225	Polygalaceae	*Polygala arvensis* Willd.	SRA	F	O		
226	Polygalaceae	*Polygala erioptera* DC.	SRA	O	Nil		
227	Primulaceae	*Anagallis arvensis* L.	SRA	F	F		
228	Ranunculaceae	*Clematis gouriana* Roxb. ex DC.	SG	O	Nil		
229	Ranunculaceae	*Clematis wightiana* Wall.	SG	O	Nil		
230	Ranunculaceae	*Delphinium malabaricum* (Huth) Munz.	SG	R	R	VU	
231	Rhamnaceae	*Rhamnus hirsuta* Wight & Arn.	CE	R	Nil		
232	Rhamnaceae	*Zizipus rugosa* Lam.	SG, PTC	O	R	DD	
233	Rubiaceae	*Catunaregam spinosa* (Thunb.) Tirveng	SG	F	R		
234	Rubiaceae	*Hamiltonia suaveolens* (Roxb.) Roxb.	SG	O	Nil		
235	Rubiaceae	*Hedyotis aspera* Heyne ex Roth	SCA	Nil	F		
236	Rubiaceae	*Hedyotis auricularia* L.	SRA	C	O		
237	Rubiaceae	*Hedyotis corymbosa* (L.) Lam.	SEP, SCA	F	Nil		
238	Rubiaceae	*Hedyotis stocksii* (Hook.f. & Thomson) R.S.Rao & Hemadri	ERS, B	C	F	DD	
239	Rubiaceae	*Hymenodictyon obovatum* Wall.	SG	F	Nil	DD	
240	Rubiaceae	*Ixora brachiata* Roxb.	SG	Nil	O	DD	
241	Rubiaceae	*Meyna laxiflora* Robyns	SG	F	O		
242	Rubiaceae	*Neanotis calycina* (Wall. ex Hook.f.) W.H.Lewis	SRA, RC, SFD	C	O		
243	Rubiaceae	*Pavetta crassicaulis* Bremek.	SG	O	F		
244	Rubiaceae	*Psydrax umbellata* (Wight) Bridson	SG	Nil	Nil		
245	Rubiaceae	*Rubia cordifolia* L.	SG	O	R		
246	Rubiaceae	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre	SG	F	Nil		
247	Rutaceae	*Atalantia racemosa* Wight & Arn.	SG	O	F		
248	Rutaceae	*Murraya koenigii* Spreng.	SG	O	O		
249	Rutaceae	*Murraya paniculata* (L.) Jack	SG	O	Nil		
250	Salicaceae	*Salix tetrasperma* Roxb.	SG	ONE	Nil		
251	Santalaceae	*Osyris quadripartita* Salzm. ex Decne	SG	O	R		
252	Sapindaceae	*Allophylus cobbe* (L.) Blume	SG	F	Nil		
253	Sapotaceae	*Xantolis tomentosa* Raf.	SG	O	R		
254	Scrophulariaceae	*Buchnera hispida* Buch.-Ham.	SCA	O	C		
255	Scrophulariaceae	*Kickxia ramosissima* (Wall.) Janch.	RC, ERS	Nil	O		
256	Scrophulariaceae	*Lindernia crustacea* (L.) F.Muell	SCA, SEP	Nil	O		LC
257	Scrophulariaceae	*Rhamphicarpa longiflora* Benth.	SP, SEP	C	F	DD	
258	Scrophulariaceae	*Sopubia delphinifolia* G.Don	SP, SEP, SCA	C	F		
259	Scrophulariaceae	*Stemodia viscosa* Roxb.	SCA, SFD	Nil	O		
260	Scrophulariaceae	*Striga gesnerioides* (Willd.) Vatke	SCA	O	Nil		
261	Scrophulariaceae	*Torenia indica* C.J.Saldanha	SP, SEP	O	Nil	DD	
262	Solanaceae	*Nicandra physalodes* (L.) Gaertn.	SRA	C	O		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
263	Solanaceae	*Solanum anguivi* Lam.	SCA	C	R		
264	Solanaceae	*Solanum virginianum* L.	SG	Nil	R		
265	Sterculiaceae	*Eriolaena quinquelocularis* Wight	SG	R	Nil	DD	
266	Sterculiaceae	*Sterculia guttata* Roxb. ex DC.	SG	Nil	R		
267	Thymelaeaceae	*Gnidia glauca* (Fresen.) Gilg.	SG	F	O		
268	Tiliaceae	*Grewia abutilifolia* Vent. ex. A.Juss.	SG	Nil	O		
269	Tiliaceae	*Grewia flavescens* Juss.	SG	F	Nil		
270	Tiliaceae	*Triumfetta annua* L.	SG	O	Nil		
271	Tiliaceae	*Triumfetta pentandra* A.Rich.	SG	F	Nil		
272	Tiliaceae	*Triumfetta rhomboidea* Jacq.	SG	F	O		
273	Tiliaceae	*Triumpheta pilosa* Roth.	SG	F	Nil		
274	Urticaceae	*Girardinia diversifolia* (Link) Friis	SG	F	R		
275	Urticaceae	*Lecanthus peduncularis* (Royle) Wedd.	B, RC, SFD	F	O		
276	Verbenaceae	*Callicarpa tomentosa* Willd.	SG	O	O		
277	Verbenaceae	*Clerodendrum serratum* Moon	SG	O	O		
278	Verbenaceae	*Gmelina arborea* Roxb.	SG	O	R		
279	Verbenaceae	*Phyla nodiflora* (L.) Greene	CE	Nil	R		LC
280	Verbenaceae	*Vitex negundo* L.	SG	O	R		
281	Vitaceae	*Cissus elongata* Miq.	SG	O	R		
282	Vitaceae	*Cissus woodrowii* (Cooke) Santapau	SG	R	R	DD	
283	Amaryllidaceae	*Crinum latifolium* L. var. *latifolium*	SRA	F	Nil		
284	Amaryllidaceae	*Pancratium sanctae-mariae* Blatt. & Halb.	SCA, SFD, RC	O	Nil	EN	
285	Amaryllidaceae	*Pancratium parvum* Dalzell	SCA, SFD, RC	C	Nil	DD	
286	Amaryllidaceae	*Pancratium triflorum* Roxb.	SRA, SFD, RC	O	R		
287	Anthericaceae	*Chlorophytum borivilianum* Sant. & R.R.Fern	SRA	R	Nil	LR	
288	Anthericaceae	*Chlorophytum glaucoides* Blatt.	SRA	O	Nil	LR	
289	Anthericaceae	*Chlorophytum laxum* R.Br.	SCA	R	O	DD	
290	Anthericaceae	*Chlorophytum tuberosum* Baker	SRA	R	O	DD	LC
291	Araceae	*Amorphophallus commutatus* Engl.	PTC, SG	O	R		
292	Araceae	*Arisaema murrayi* (Graham) Hook.	SRA	F	O	DD	
293	Araceae	*Remusatia vivipara* (Roxb.) Schott	SFD, SG	F	Nil		
294	Araceae	*Sauromatum venosum* Schott.	PTC, SG	R	Nil		LC
295	Arecaceae	*Caryota urens* L.	SG	O	Nil		
296	Asparagaceae	*Asparagus ramosissimus* Baker	SG, SFD	O	F	DD	
297	Colchicaceae	*Gloriosa superba* L.	SG, SRA	O	Nil	DD	LC
298	Colchicaceae	*Iphigenia stellata* Blatt.	SCA	C	O	VU	
299	Colchicaceae	*Iphigenia indica* (L.) A.Gray ex Kunth	SCA	C	F	DD	
300	Commelinaceae	*Commelina benghalensis* L.	SCA, RC, SFD	O	Nil		LC
301	Commelinaceae	*Commelina suffruticosa* Blume	SCA	Nil	O		
302	Commelinaceae	*Cyanotis tuberosa* (Roxb.) Schult.f. var. *tuberosa*	SRA	F	R		
303	Commelinaceae	*Cyanotis fasciculata* (Heyne ex Roth) Schult.f.	RC, SCA	Nil	F		LC
304	Commelinaceae	*Murdannia spirata* G.Brückn	SEP	Nil	O		
305	Commelinaceae	*Murdannia versicolor* G.Brückn	SEP, SCA	O	Nil	DD	
306	Cyperaceae	*Bulbostylis densa* Hand.-Mazz.	SEP, SP	R	Nil		LC

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
307	Cyperaceae	*Carex cruciata* Wahlenb	SEP, SP	O	Nil		
308	Cyperaceae	*Cyperus difformis* L.	SEP, SP	F	C		
309	Cyperaceae	*Cyperus iria* L.	SEP, SP	C	C		
310	Cyperaceae	*Cyperus rotundus* L.	SRA	F	Nil		LC
311	Cyperaceae	*Cyperus tenuispica* Steud.	SEP, SP	C	Nil		LC
312	Cyperaceae	*Eriophorum comosum* (Wall.) Nees	SP, SFD	O	Nil		
313	Cyperaceae	*Juncellus pygmaeus* C.B.Cl.	SP, SFD	F	O		
314	Cyperaceae	*Kyllinga pumila* Michx	SCA	O	F		
315	Cyperaceae	*Mariscus paniceus* (Rottb.) J.Vahl. var. *paniceus*	SCA, SFD	F	Nil		LC
316	Cyperaceae	*Pycreus sanguinolentus* (Vahl) Nees	SCA, RC	O	Nil		LC
317	Cyperaceae	*Rhynchospora wightiana* Steud.	SRA	C	Nil		
318	Cyperaceae	*Scirpus michelianus* L.	SEP, SP	O	R		
319	Dioscoreaceae	*Dioscorea bulbifera* L.	SG	Nil	F		
320	Dioscoreaceae	*Dioscorea oppositifolia* L.	SG, SRA	O	O		
321	Dioscoreaceae	*Dioscoria pentaphylla* L.	SG, SRA	O	O		
322	Eriocaulaceae	*Eriocaulon cookei* Punekar, Malpure & Lakshmin.	SEP, SP	O	Nil	DD	LC
323	Eriocaulaceae	*Eriocaulon eurypeplon* Körn	SEP, SP, SFD	Nil	O	DD	LC
324	Eriocaulaceae	*Eriocaulon minutum* Hook.f.	SEP, SP	R	C	DD	LC
325	Eriocaulaceae	*Eriocaulon parviflorum* (Fyson) R.Ansari & N.P.Balakr.	SEP, SP	Nil	R	DD	LC
326	Eriocaulaceae	*Eriocaulon ritchieanum* Ruhland	SEP, SP, SFD	C	Nil	DD	LC
327	Eriocaulaceae	*Eriocaulon stellulatum* Korn.	SEP, SP, SRA	O	F	DD	LC
328	Hyacinthaceae	*Drimia indica* (Roxb.) Jessop	ERS	O	R		
329	Hyacinthaceae	*Ledebouria revoluta* (L.f.) Jessop.	ERS, SCA	O	F		
330	Hydrocharitaceae	*Blyxa aubertii* Rich.	SEP, SP	C	Nil		LC
331	Hydrocharitaceae	*Vallisneria spiralis* L.	SEP, SP	F	Nil		LC
332	Hypoxidaceae	*Curculigo orchioides* Gaerrtn.	SCA	F	F		
333	Hypoxidaceae	*Hypoxis aurea* Lour.	SRA	C	F		
334	Orchidaceae	*Aerides maculosum* Lindl.	SG, PTC	O	O	DD	
335	Orchidaceae	*Aerides crispa* Lindl.	SG, PTC	C	Nil	DD	
336	Orchidaceae	*Bulbophyllum fimbriatum* H.Perrier	SG, PTC	O	Nil	DD	
337	Orchidaceae	*Dendrobium aqueum* Lindl.	SG, PTC	O	Nil	DD	
338	Orchidaceae	*Dendrobium barbatulum* Lindl.	SG, PTC	C	O	DD	
339	Orchidaceae	*Dendrobium herbaceum* Lindl.	SG, PTC	F	Nil	DD	
340	Orchidaceae	*Dendrobium microbulbon* A.Rich	SG, PTC	O	Nil	DD	
341	Orchidaceae	*Eria microchila* Ames	SG, PTC	O	Nil	DD	
342	Orchidaceae	*Eria reticosa* Wight	SG, PTC, B	O	Nil		
343	Orchidaceae	*Eulophia ochreata* Lindl.	SRA	O	Nil	DD	
344	Orchidaceae	*Habenaria foliosa* A. Rich var. *foliosa*	SRA	F	Nil	EN	
345	Orchidaceae	*Habenaria diphylla* (Nimmo) Dalzell	SCA, SFD	O	Nil		
346	Orchidaceae	*Habenaria grandifloriformis* Blatt. & McC.	SCA	C	F	DD	
347	Orchidaceae	*Habenaria heyneana* Lindl.	SCA	C	Nil	DD	
348	Orchidaceae	*Habenaria longicorniculata* J.Graham	SRA	R	R	DD	
349	Orchidaceae	*Oberonia recurva* Lindl.	SG, PTC	R	R		
350	Orchidaceae	*Pecteilis gigantea* Raf.	SRA	R	Nil		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
351	Orchidaceae	*Thunia venosa* Rolfe.	SG, PTC	F	Nil		
352	Poaceae	*Aristida stocksii* (Hook. f.) Domin	B, CE, SFD	Nil	O		
353	Poaceae	*Aristida adscensionis* L.	B, CE, SFD	Nil	C		
354	Poaceae	*Aristida redacta* Stapf.	ERS	Nil	F		
355	Poaceae	*Arthraxon hispidus* (Thunb.) Makino var. *hispidus*	CE, SCA, SFD, B	C	Nil		
356	Poaceae	*Arthraxon hispidus* (Thunb.) Makino var. *junnarensis* (Jain & Hemadri) Welzen	SCA	C	C	EN	
357	Poaceae	*Arthraxon jubatus* Hack.	CE, SCA, PTC	C	C	VU	
358	Poaceae	*Arthraxon lanceolatus* Hochst. var. *hindustanicus* Jain & Deshpande	SCA, CE	Nil	F		
359	Poaceae	*Arthraxon lanceolatus* Hochst. var. *meeboldii* (Stapf.) Welzen	SRA	F	O	DD	
360	Poaceae	*Arthraxon lanceolatus* Hochst. var. *villosus* (C.E.C. Fischer) Welzen	SCA	C	Nil	DD	
361	Poaceae	*Arthraxon lancifolius* Hochst.	SFD, RC, SCA	C	Nil		
362	Poaceae	*Arundinella tuberculata* Munro ex Lisboa	SRA	O	O		
363	Poaceae	*Arundinella metzii* Hochst. ex Miq.	SCA, B	C	C	DD	
364	Poaceae	*Arundinella pumilla* Steud.	SCA	F	Nil		
365	Poaceae	*Arundinella spicata* Dalzell	PTC	C	Nil	DD	
366	Poaceae	*Bambusa arundinacea* (Retz.) Willd.	SG	Nil	R		
367	Poaceae	*Capillipedium huegelii* (Hack.) Stapf.	ERS	C	Nil		
368	Poaceae	*Chloris virgata* Sw.	ERS, SCA	O	F		
369	Poaceae	*Chrysopogon polyphyllus* Blatt. & McC.	SCA	C	Nil	DD	
370	Poaceae	*Coix lacryma-jobi* L.	SP, SEP	C	O		
371	Poaceae	*Cymbopogon martini* (Roxb.) Wats.	SRA	Nil	O		
372	Poaceae	*Cynodon dactylon* (L.) Pers.	SRA	F	O		
373	Poaceae	*Dichanthium armatum* Blatt. & Mc.C.	SCA, SFD	C	Nil	VU	
374	Poaceae	*Dichanthium jainii* (Desh. & Hemadri) Desh.	SCA	C	Nil	EN	
375	Poaceae	*Dichanthium odoratum* (Lisboa) Jain & Desh.	SG, SRA	O	Nil	DD	
376	Poaceae	*Dichanthium huegeli* (Hack.) Jain & Desh.	SG	O	Nil	DD	
377	Poaceae	*Digitaria ciliaris* (Retz.) Koeler	ERS, RC	F	F		
378	Poaceae	*Digitaria longiflora* (Retz.) Pers.	SFD, SCA	F	Nil		
379	Poaceae	*Digitaria stricta* Roth *ex* Roem. & Schult.	RC, CE, SFD	O	Nil		
380	Poaceae	*Dimeria hohenackeri* Hochst. ex Miq.	SG	C	R	DD	EN
381	Poaceae	*Dimeria ornithopoda* Trin. var. *ornithopoda*	SG	C	Nil		LC
382	Poaceae	*Dimeria stapfiana* C.E.Hubb. ex Pilg.	SRA	C	Nil	DD	
383	Poaceae	*Echinochloa colonum* (L.) Link	SRA	C	Nil		LC
384	Poaceae	*Echinochloa crusgalli* (L.) P.Beauv.	SRA	O	Nil		LC
385	Poaceae	*Eleusine coracana* (L.) Gaertn.	SRA	Cult	Nil		
386	Poaceae	*Eragrostis gangetica* (Roxb.) Steud.	SFD, SCA	O	F		
387	Poaceae	*Eragrostis nutans* (Retz.) Nees ex Steud.	SCA, CE	O	Nil		
388	Poaceae	*Eragrostis japonica* (Thunb.) Trin.	SCA	O	Nil		
389	Poaceae	*Eragrostis pilosa* (L.) P.Beauv.	SCA	F	F		
390	Poaceae	*Eragrostis tenuifolia* (A.Rich.) Steud.	SCA	O	F		
391	Poaceae	*Eragrostis unioloides* (Retz.) Steud.	SCA	F	F		LC
392	Poaceae	*Eulalia fimbriata* (Hack.) O.Ktze.	SRA	O	Nil		
393	Poaceae	*Eulalia trispicata* (Schult.) Henrard	SRA	C	Nil		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
394	Poaceae	*Garnotia courtallensis* (Arn. & Nees) Thw.	PTC, SCA	O	Nil		LC
395	Poaceae	*Garnotia stricta* Brongn.	PTC, SCA	C	O		
396	Poaceae	*Garnotia tenella* (Arn. ex Miq.) Jan.	PTC, SCA	C	O		
397	Poaceae	*Glyphochloa forticulata* (C.E.C.Fischer) W.D.Clayton	SFD	C	O	DD	
398	Poaceae	*Hackelochloa granularis* (L.) O.Ktze.	SRA	Nil	C		
399	Poaceae	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.	SCA	F	F		
400	Poaceae	*Heteropogon ritchiei* (Hook. f.) Blatt. & McC.	SRA	C	Nil	DD	
401	Poaceae	*Heteropogon triticeus* (R. Br.) Stapf ex Craib	SCA	F	Nil		
402	Poaceae	*Indopoa paupercula* (Stapf) Bor	SCA	F	Nil	DD	
403	Poaceae	*Isachne bicolor* Naik & Patunkar	CE, RC, SFD	C	R	EN	VU
404	Poaceae	*Isachne borii* Hemadri	SEP	O	Nil	EN	
405	Poaceae	*Isachne elegans* Dalz. ex Hook.f.	SCA	O	Nil	DD	LC
406	Poaceae	*Isachne globosa* (Thunb.) O.Ktze. var. *deffusa* (Trin. ex Hook.f.) Senaratna	SCA	O	Nil		
407	Poaceae	*Isachne globosa* (Thunb.) O.Ktze. var. *globosa*	RO	O	F		LC
408	Poaceae	*Isachne gracilis* C.E.Hubb.	BCS	R	O		
409	Poaceae	*Isachne lisboae* Hook.f.	BCS	O	Nil	EN	
410	Poaceae	*Ischaemum impressum* Hack. in DC.	BCS	O	Nil		
411	Poaceae	*Ischaemum indicum* (Houtt.) Merr. subvar. *indicum* J. Arnold	BCS	F	Nil		LC
412	Poaceae	*Ischaemum kingii* Hook.f.	BCS	R	Nil		
413	Poaceae	*Iseilema laxum* Hack.	ERS, CE	Nil	O		
414	Poaceae	*Jansenella griffithiana* (C. Muell.) Bor	SRA	C	Nil		
415	Poaceae	*Jansenella neglecta* Yadav, Chivalkar & Gosavi	SCA	C	Nil	DD	
416	Poaceae	*Lophopogon tridentatus* (Roxb.) Hack.	SCA	Nil	C	DD	
417	Poaceae	*Manisuris forticulata* C.E.C.	ERS	Nil	O		
418	Poaceae	*Melanocenchris jacquemontii* Jaub. & Spach.	ERS, RC	F	O		
419	Poaceae	*Oropetium thomaeum* (L.f.) Trin.	SCA, SFD	Nil	O		
420	Poaceae	*Oropetium villosulum* Stapf. ex Bor	SRA	Nil	O		
421	Poaceae	*Panicum psilopodium* Trin.	SRA	C	F		
422	Poaceae	*Panicum sumatrense* Roth. ex R. & S.	SRA	O	R		LC
423	Poaceae	*Paspalum canarae* (Steud.) Veldk. var. *canarae*	ERS	C	C		LC
424	Poaceae	*Paspalum canarae* (Steud.) Veldk. var. *fimbriatum* (Bor) Veldk.	ERS	R	Nil	DD	
425	Poaceae	*Paspalum scrobiculatum* L.	SFD	O	Nil		LC
426	Poaceae	*Pennisetum pedicellatum* Trin.	SRA	O	Nil		
427	Poaceae	*Phalaris minor* Retz. var. *minor*	SCA	C	Nil		
428	Poaceae	*Pseudanthistiria heteroclita* (Roxb.) Hook.f.	SEP, SFD	F	Nil	DD	
429	Poaceae	*Pseudodichanthium serrafalcoides* (Cooke & Stapf.) Bor	SRA	R	R		
430	Poaceae	*Sehima nervosum* (Rottl.) Stapf.	ERS	F	Nil		
431	Poaceae	*Setaria pumila* (Poir) R. & S.Syst.	ERS, RC	O	R		
432	Poaceae	*Setaria tomentosa* (Roxb.) Kunth	SCA, CE, B	O	Nil		
433	Poaceae	*Spodiopogon rhizophorus* (Steud.) Pilger	PTC, SCA	O	Nil		
434	Poaceae	*Sporobolus indicus* (L.) R.Br.	SCA	R	R		
435	Poaceae	*Thelepogon elegans* Roth ex R. & S.	CE, SCA	O	Nil		
436	Poaceae	*Themeda quadrivalvis* (L.) O.Ktze.	SRA	C	Nil		

	Family	Botanical name	Micro-habitats	Occurrence		Status of taxon as per	
				DP	NP	BSI	IUCN 2013
437	Poaceae	*Themeda triandra* Forssk.	SRA	C	F		
438	Poaceae	*Tragus racemosus* (L.) Allioni	ERS	Nil	F		
439	Poaceae	*Tripogon bromoides* R. & S.	SCA, SFD	F	R		
440	Smilacaceae	*Smilax ovalifolia* Roxb.	SG	Nil	O		
441	Typhaceae	*Typha angustifolia* L.	SP, SEP	O	Nil		LC
442	Zingiberaceae	*Curcuma pseudomontana* Grah.	SG, SRA	F	F	DD	VU
443	Zingiberaceae	*Zingiber neesanum* (Grah.) Ramamoorthy	SG, SRA	O	R	DD	

Note: The IUCN categories are given only for Indian endemic taxa as per the BSI and IUCN. Please refer text for habitat details.
Occurrence: C - Common; F - Frequent; O - Occasional; R - Rare. DD - Data Deficient; EN - Endangered; VU - Vulnerable; LC - Least Concern; NT - Neat Threatened

because of the elongated nature of the DP towards the south-east. These ROs are relatively different in the composition of the soil strata. DP is mainly basalt with a few areas of lateritic soil and has yellowish to brown gravelly soil. DP is topped by a hillock, composed entirely of large boulders and fractured rocks, similar to 'kopje' or tor formations. Generally, the soil thickness ranges from 1cm to a few meters. The porosity of the strata is relatively more on it, than that in NP. NP is purely basaltic with brown-black hard rock and very little soil on it. The soil thickness usually ranges from 0–1 m. The dominant habitat on both the ROs is quite different. DP has more diversity in the microhabitats than NP. The diversity of microhabitats and larger area could be the reasons for accommodating more angiosperm species. These ecological settings support the moist semi-evergreen forest type on DP. On NP the forest type tend towards moist to dry deciduous types. A total of 11 types of microhabitats are identified in the study area following the microhabitat classification in the Western Ghats by Watve (2008) and Lekhak & Yadav (2012) with some modifications. Each microhabitat has characteristic features with respect to soil, water and species composition and are described below.

1. **Boulders [B]**: They are large rocks found on the plateau either aggregated or scattered. They are usually covered by algae, lichens and mosses. Some angiosperms found on them are, *Aerides crispa, Begonia crenata, Dendrobium herbaceum, D. barbatulum, Eria reticosa* amidst mosses.

2. **Cliffs or Crust Edges [CE]**: The cliff is a specific habitat on the edges of the plateau with steep, almost 90^0 drop from the plateau (Image 5). The cliffs support populations of *Pinda concanensis, Heracleum grande, Ceropegia rollae, Chlorophytum glaucoides* and *Pancratium triflorum.* Besides these there are *Utricularia striatula*, *Begonia crenata, Sonerila scapigera* and

Image 5. Slope vegetation comprising of *Crinum latifolium, Euphorbia* sp., and other plant species.

grasses like *Arthraxon* sp., *Arundinella metzi, Themeda* spp.

3. **Exposed Rock Surfaces [ERS]**: The flat or uneven rock surfaces, exposed to direct sunlight. During the rainy season they are covered by grasses and other ephemerals (Image 6). Common plants occupying this microhabitat are *Eriocaulon cookie, E. minutum, E. ritchieanum, E. stellulatum* and *Utricularia* spp.

4. **Rock Crevices [RC]**: The rock crevices are on the plateaus as well as on crests again providing a different microhabitat. The small crevices support populations of *Murdania, Eriocaulon* and some grass species. Larger crevices support a population of *Curcuma pseudomontana, Ceropegia rollae, C. media, Pimpinella adscendens, P. tomentosa, Senecio bombayensis, S. dalzellii,* ferns and grasses.

5. **Seasonal Ponds [SP]**: They are small ponds that have deep bowl like depressions filled with water during and post monsoon. They are occupied by common aquatic species, such as *Nymphoides indica, Persicaria glabra, Rotala ritchiei* and *Marsilea minuta.* Some

Image 6. Early monsoon vegetation on exposed rock surfaces and soil covered areas among them.

Image 7. Ephemeral flush vegetation on soil covered areas and plateau tree cover in the background on soil rich areas.

grasses, sedges and *Isachne* species are found on the margins. *Typha angustifolia* was also recorded in one of the seasonal ponds on DP.

6. **Small Ephemeral Pools [SEP]**: The very shallow depressions which get filled with water during rains. Generally, there is none or very less deposition of soil. These are occupied by *Pogostemon stellatus, Rotala* sp. and some algal members. They support the growth of frog tadpoles, crabs and small fishes.

7. **Soil-covered Areas [SCA]**: The large areas or slopes having about 10–20 cm thick soil covering the bedrock forms this habitat. It is generally not inundated during the monsoons. It supports the ephemeral flush vegetation giving a mass effect of individual or composition of species (Image 7). The SCAs are occupied by large populations of *Isoetes dixitei*, *Ophioglossum* spp., *Drosera indica, Habenaria grandifloriformis, H. heyneana, Hypoxis aurea, Curculigo orchoides, Impatiens lawii*, *Iphigenia stellata, Smithia* spp., *Linum, Senecio* spp., *Rhamphicarpa longiflora, Utricularia albocaerulea*, *U. praeterita, U. reticulata, U. purpurascens* and grasses.

8. **Soil-filled Depressions [SFD]**: These are small convex areas within or outside the SCA having about 20–30 cm thick humus rich soil. SFDs are generally inundated temporarily after rains. The species found in this microhabitat are *Eriocaulon tuberiferum, Isachne lisboae, Paspalum canarae* var. *canarae, Pycreus sanguinolentus, Rotala densiflora* and *Smithia racemosa.*

9. **Soil-rich Areas [SRA]**: These habitats have soil to a depth of about 30–60cm. SRAs are found scattered in interrupted plateau tree cover and fringes of sacred groves. SRAs are occupied by *Curcuma pseudomontana*, *Curculigo orchioides, Cyanotis tuberosa, Cajanus lineatus, Pancratium sanctae-marae, P. triflorum, Crinum latifolium, Drimia indica, Fimbristylis dichotoma, Hypoxis aurea, Smithia racemosa, S. capitata, S. purpurea* and *S. setulosa*. Some SRAs are private lands and on it rice and finger millet are cultivated. In some places *Maytenus senegalensis, Gnidia glauca, Leea indica* and other species form shrub vegetation supporting *Ceropegia media, Senecio dalzellii, S. hewrensis*, *Asparagus ramosissimus* and other herbaceous species.

10. **Plateau Tree Cover [PTC]**: The soil rich areas with soil depth of about 60–100 cm support the dwarf tree cover on the plateaus. The vegetation is mainly composed of *Memecylon umbellatum* and *Atalantia racemosa* with infrequent occurrence of *Gnidia glauca* and *Actinodaphne angustifolia.* The average plant height is 3m. PTC is discontinuous and open canopy is occupied by shrubs such as *Maytenus senegalensis, Leea indica* and herbaceous vegetation. The vegetation supports the population of diverse herbaceous species mentioned in category 9 above. The trees support luxuriant growth of orchids—*Aerides maculosum, A. crispa*, *Dendrobium herbaceum, D. barbatulum* and epiphytic ferns like *Microsorium membranaceum* and *Lepisorus nudus*. On the ground the community of *Impatiens lawii, I. minor, I. oppositifolia, Pimpinella adscendens, P. tomentosa* and *Pinda concanensis* is predominant.

11. **Sacred groves [SG]**: The DP has a total of four sacred groves, three in the Ambe Village and one at Durgawadi. Soil depth is >100cm. These sacred groves have a typical floristic composition (Image 8). The main sacred grove of *Durgadevi* has a semi-evergreen composition of *Mangifera indica, Olea dioica, Memecylon umbellatum, Syzygium cumini, Xantolis tomentosa, Atalantia racemosa, Actinodaphne angustifolia, Diospyros montana,*

Image 8. Boulders and sacred grove on Durgawadi Plateau.

Terminalia bellirica and *T. chebula* having infrequent elements such as *Caryota urens* and *Allophylus cobbe*. The understory of the sacred grove is rich in *Rubia cordifolia, Sonerila scapigera, Habenaria foliosa* and *Cynoglossum amabile*. Among the epiphytes orchids dominate with *Hoya wightii* and ferns like *Lepisorus nudus* and *Microsorium membranaceum*.

At NP there are two sacred grove, that have a community of *Bambusa arundinacea, Flacourtia indica, F. latifolia, Memecylon umbellatum, Terminalia bellirica, T. chebula, T. elliptica*, *Maytenus senegalensis* and *Heterophragma quadriloculare.* All the above microhabitats are recorded on DP, while on NP the boulders and seasonal ponds are absent while soil rich areas are very less.

General vegetation on the rock outcrops

General vegetation shows a great variation especially during the monsoon months. Different plant communities successively dominate in the monsoon season. During May–June, i.e., at the onset of the monsoon bulbous and cormatous species *Amorphophalus commutatus, Drimia indica, Sauromatum venosum, Pancratium* spp., and *Crinum latifolium* flower first.

The pre-monsoon vegetation is followed by the flush of ground orchids during June–July including *Habenaria grandifloriformis, H. rariflora* along with *Curculigo orchoides*, *Isoetes dixitei*, *Ophioglossum graminium* and *O. nudicaule*.

In the month of July–August the entire RO becomes lush green with vegetative growth of *Senecio* sp., *Exacum* sp., *Smithia* sp. and grasses. During this period, *Drosera indica, Utricularia graminifolia, U. striatula* and *Exacum lawii* are found in the flowering state.

September–October is the period of the greatest changes in the vegetation on the ROs. *Smithia* sp. along with *Cythocline purpurea* bloom first, which are then replaced by *Senecio* sp. along with *Pogostemon stellatus* and *Cythocline lutea* and then grasses follow the sequence of flowering. The abundance of *Smithia purpurea* and *Cythocline lutea* are unique features of the basaltic plateau, not observed on lateritic plateaus.

Floristic composition

The total area of both these ROs in the present study is very small but great floristic diversity exists on them. The total species and infra specific phanerogamic taxa recorded are 443 on both the plateaus belonging to 297 genera of 90 families (Table 1). The species and infraspecific taxa consist of 161 monocots and 282 dicots. DP harbors 360 species and infraspecific taxa of 242 genera and 85 families, while NP has 249 species and infraspecific taxa of 203 genera and 74 families. A total of 1390 species including cultivated ones have been reported in the Flora of Junnar Taluka (Rahangdale 2009). The area under study represents almost 1/3rd the floristic diversity of Junnar by species number, which indicates the species richness in this relatively small geographic area.

A total of 165 species and taxa of infraspecific rank, 148 genera and 68 families are commonly shared by both the ROs. The common shared taxa constitute only 37.16% species and infraspecific taxa, 49.83%

Table 2. The floristic composition on rock outcrops.

	Both Rock Outcrops			Durgawadi plateau (DP)			Naneghat Plateau (NP)		
	Family	Genera	Species	Family	Genera	Species	Family	Genera	Species
Total	90	297	443	85	242	360	74	203	249
Dicot	71	207	282	67	161	218	58	146	169
Monocot	19	90	161	18	81	142	16	57	80
Absent				**5**	**55**	**83**	**16**	**94**	**194**
Common	**68**	**148**	**165**	**% of absent taxa**					
% of common taxa	75.56	49.83	37.16	5.56	18.52	18.92	19.10	31.65	43.92

genera and 75.56% families of the total taxa recorded (Table 2). This indicates that the ROs studied are close to each other and share common taxa of higher ranks, i.e., families to above 75%; but it is significant to note that the taxa below the genus level are not commonly shared and difference with respect to them is about 63%. Therefore floristically, these two ROs are very different and diverse from each other, indicating a high level of beta diversity for these communities. Burke (2003) had suggested a high level of beta diversity for tropical rock outcrops in general due to their isolation. In the present case these two locations are not much isolated from surrounding low lying landscapes but topographically and ecologically are diverse from each other. Classically, the more the distance is between the sites, less the floristic affinity/similarity among them (Burke 2005b), which means there must be more similarities among adjacent sites. Plant communities are dynamic entities and influenced by many seen and unseen factors such as environmental variables, diversity of surrounding areas with respect to species, climate, topography, connectivity and appropriate corridors for different communities between the sites. Sites in the present study are connected geographically but separated by a valley and one fortress between them. The anthropogenic influence on NP is relatively more than on DP. This indicates that the area under study is heterogeneous though adjacent to each other and must be considered as floristically and ecologically separate entities.

The present study brings a significant finding about the floristic composition studies; that random sampling done during many of the studies or EIAs could be misleading and may not provide complete floristic diversity as evident in this case. Though these ROs are only about 5–10.5 km apart by aerial distance and fall under the same vegetation and climatic zones of the Western Ghats, the sharing of species is only 37% and they differ significantly in 2/3 diversity of the taxa. This is typical of a hotspot like the Western Ghats, where geographical isolation can lead to speciation and floristic diversification below genus level even at short distances; this is supported by the findings of the present study. Hence, it can be concluded that micro-level inventories of any area under study for any purpose must be taken to reveal actual diversity and its significance.

Of the total 443 taxa, 140 are Indian endemics belonging to 96 genera and 42 families; categorized under different threat categories (Ahmedullah & Nayar 1987; Nayar & Sastry 1987–89; Mishra & Singh 2001; Gaikwad & Yadav 2004). The endemic taxa in the study area comprises 31.53% of the total recorded species and infraspecific taxa indicating existence of significant number of endemic taxa at these two ROs. At DP the endemic taxa are, 133 (36.94%) belonging to 94 genera and 41 families out of 360 taxa recorded from RO while, that from NP are 64 taxa (25.70% of 249) of 51 genera and 27 families. The rock outcrops and isolated special habitats are places of origin and evolution of many narrow endemic taxa throughout the world especially in Africa, America, Australia and India (Watve 2008). It is also evident from studies in the past that new taxa are being described continuously from DP and its surrounding habitats by taxonomists (Rahangdale 2009).

The 10 most speciose families in the outcrops are Poaceae (88 spp.), Asteraceae (35 spp.), Fabaceae (28 spp.), Orchidaceae (18 spp.), Rubiaceae (14 spp.), Cyperaceae and Lamiaceae (13 spp. each), Acanthaceae and Euphorbiaceae (11 spp. each) and Asclepiadaceae (10 spp.). Comparison of the occurrence of most speciose families on both the ROs shows that, the family Orchidaceae and Cyperaceae are poorly represented at NP (5 spp. each). The members of Orchidaceae inhabit diverse niches such as, epiphytic, understorey of forests and open soil rich areas and sometimes saxicolous conditions, which are dominant at DP. The Cyperaceae are water loving plants and require pools and water saturated soils. Such microhabitats are again predominant at DP and less at NP. These observations are in accordance with the ecological and climatic conditions on both the ROs.

It is evident from the list of species in Table 1 that, ROs have a higher number of annual and ephemeral taxa comprising Poaceae, Asteraceae and Anthericaceae members. These species generally form ephemeral flush vegetation on the outcrop during pre and post monsoon months: *Smithia* sp., *Utricularia* sp., *Eriocaulon* sp., *Senecio* sp., *Habenaria* sp. and grasses especially *Arundinella metzii, A. spicata, Arthraxon hispidus, A. jubatus, Dimeria hohenakeri, Eragrostis* sp. and *Garnotia stricta*. The tree cover in the sacred grove is of normal height with big trees attaining a height of about 20m in case of *Mangifera indica, Diospyros montana* and about 10–15 m for *Memecylon umbellatum*. But the tree cover on the plateau is of stunted growth with an average height of 3m for *Memecylon umbellatum, Gnidia glauca, Atalantia racemosa* due to shallow soil strata on it. The average grass and herb height on the DP is 0.3m on the outcrop. The unique species of which only a single specimen each was recorded is *Salix tetrasperma* and *Careya arborea* at DP.

CONCLUSION

The study area comprised two rock outcrop areas on the high hill escarpment of Western Ghats and an aerial distance between them ranging from 5–10.5 km. These ROs fall under the same climatic zone and have a high level of floristic diversity within the boundaries of these small ROs. In such situations it is generally presumed that both the areas must have maximum similarities with respect to ecology and floristic compositions. The present study washes out such presumptions of similarity between the two areas, showing 63% differences between floristic compositions of these two ROs. They also differ in having diverse microhabitats on the plateaus. It is also noteworthy that, the microhabitats on these ROs have specific representatives of the flora. The dissimilarity in the floristic composition is attributed to environmental variables; especially altitude, topography, connectivity and appropriate corridors for different communities between the sites. On this basis DP and NP should be considered as separate entities while considering further studies.

The studied sites are geographically adjacent to each other, but at the same time are different in floristic composition and microhabitat types. Therefore, the study emphasizes the need of micro level inventories of smaller areas by taking intensive surveys for documentation of different aspects of the abiotic and biotic diversity as well as other environmental and anthropogenic variables. Care should be taken not to neglect a small area/outcrop while designing random sampling models as the method followed in most of the floristic, ecological and scientific studies and Environmental Impact Assessments (EIAs) for setting up of major projects.

REFERENCES

Ahmedullah, M. & M.P. Nayar (1987). *Endemic Plants of the Indian Region - Volume 1: Peninsular India*. Botanical Survey of India, Kolkata, 264pp.

Aitawade, M.M. & S.R. Yadav (2012). *Mucuna sanjappae* a new species from the north Western Ghats, India. *Kew Bulletin* 67(3): 539–543.

Almeida, M.R. (1996). *Flora of Maharashtra - Volume 1.* Orient Press, Mumbai, 294pp.

Almeida, M.R. (1998). *Flora of Maharashtra - Volume Vol. 2.* Orient Press, Mumbai, 457pp.

Almeida, M.R. (2001). *Flora of Maharashtra - Volume 3.* Orient Press, Mumbai, 567pp.

Almeida, M.R. (2003). *Flora of Maharashtra - Volume 4.* Orient Press, Mumbai, 471pp.

Almeida, M.R. (2009). *Flora of Maharashtra - Volume 5.* Orient Press, Mumbai, 495pp.

Ansari, M.Y. (1984). Asclepiadaceae: Genus *Ceropegia* L. *Fascicles of Flora of India* 16. Botanical Survey of India, Calcutta, 34pp.

Ansari, M.Y., R.S. Raghavan & K. Hemadri (1970). *Chlorophytum bharuchae* Ansari, Raghavan et Hemadri - a new species of Liliaceae from Western Ghats. *The Indian Forester* 96: 304–306.

Ansari, R. & N.P. Balakrishnan (1994). *The Family Eriocaulaceae in India.* Bishen Singh Mahendra Pal Singh, Dehradun, India, 188pp.

Bhattarai U., P. Tetali & S. Kelso (2012). Contributions of vulnerable hydrogeomorphic habitats to endemic plant diversity on the Kas Plateau, Western Ghats. *Springer Plus* 1: 25; http:/dx.doi.org/10.1186/2193-1801-1-25

Billore, K.V. & K. Hemadri (1970). *Leucas deodikarii* Billore et Hemadri - a new species of Lamiaceae from Sahyadri range, Maharashtra State. *The Indian Forester* 96: 858–860.

Blatter, E. & C. McCann (1935). *The Bombay Grasses*, *Scientific Monograph No. 5.* Imperial Council of Agricultural Research, New Delhi, xxi+324pp.

Burke, A. (2003). Inselbergs in a changing world - global trends. *Diversity and Distributions* 9: 375–383; http://dx.doi.org/10.1046/j.1472-4642.2003.00035.x

Burke, A. (2005a). Vegetation types of mountain tops in Damaraland, Namibia. *Biodiversity and Conservation* 14: 1487–1506; http://dx.doi.org/ 10.1007/s10531-004-9788-x

Burke, A. (2005b). Biodiversity patterns in arid, variable environments. *Mountain Research and Development* 25(3): 228–234; http://dx.doi.org/10.1659/0276-4741(2005)025[0228:BPIAVE]2.0.CO;2

Cooke, T. (1901–1908). *The Flora of the Presidency of Bombay - Volumes 1 & 2.* London (Botanical Survey of India, Calcutta, Vol. 1–3. Reprint of 1958).

Dalzell, N.A. & A. Gibson (1861). *The Bombay Flora* or *Short Descriptions on all the Indigenous plants together with a supplement of Introduced and Naturalized species.* Education Society's Press, Byculla, 444pp.

Deshpande, U.R. & K. Hemadri (1971). *Bothriochola janii* Deshpande et Hemadri - a new grass from the Sahyadri ranges, Maharashtra State. *The Indian Forester* 97: 593–596.

Gaikwad, S.P. & S.R. Yadav (2004). Endemic flowering plant species of Maharashtra and their possible utilization, pp. 28–58. In: Pullaiah, T. (ed.). *Biodiversity in India - Volume 3*. Regency Publications, New Delhi.

Hemadri, K. (1968a). A new *Ceropegia Linn.* (Asclepiadaceae) from Western Ghats, Maharashtra. *Bulletin of Botanical Survey of India* 10(2): 123–125.

Hemadri, K. (1968b). New interesting plant records. *The Indian Forester* 94: 808–811.

Hemadri, K. (1970). The flora of Junnar and surroundings, Poona District, (Maharashtra State). PhD Thesis. Botanical Survey of India, Western Regional Centre, Pune, University of Pune.

Hemadri, K. (1971a). *Isachne borii* Hemadri - a new grass from India. *The Indian Forester* 97: 223–225.

Hemadri, K. (1971b). Two new species of Fabaceae from India. *The Indian Forester* 97: 65–69.

Hemadri, K. (1980). *Grasses of Junnar and surroundings, Poona District* (*Maharashtra State*). Bishen Singh Mahendra Pal Singh, Dehradun, 127pp.

Hemadri, K. & K.V. Billore (1970). *Ischaemum raizadae* Hemadri & Billore - a new grass from India. *The Indian Forester* 96: 318–321.

Hemadri, K. & M.Y. Ansari (1971). *Ceropegia mahabalei* Hemadri & Ansari - A new species of Asclepiadaceae from Sahyadri range, Western Ghats (Maharashtra). *The Indian Forester* 97: 105–108.

Hooker, J.D. (1872–1897). *The Flora of British India - Volumes 1–7*. London. (Reprint 2006, Bishen Singh Mahendra Pal Singh, Dehradun).

IPNI (2013). <http://www.ipni.org> On-line version dated 29 April 2013.

IUCN (2013). IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Downloaded on 22 April 2014.

Jacobi, C.M., F.F. do Carmo, R.C. Vincent & J.R. Stehmann (2007). Plant communities on ironstone outcrops: a diverse and endangered

Brazilian ecosystem. *Biodiversity & Conservation* 16: 2185–2200; http://dx.doi.org/10.1007/s10531-007-9156-8

Jain, S.K. & K. Hemadri (1971). A new grass from India - *Arthraxon junnerensis* sp. nov. *Journal of the Bombay Natural History Society* 68: 300–301.

Jain, S.K. & R.R. Rao (1977). *Field & Herbarium Methods*. Today & Tomorrow's. Printers & Publishers, Delhi, 157pp.

Lekhak, M.M. & S.R. Yadav (2012). Herbaceous vegetation of threatened high altitude lateritic plateau ecosystems of Western Ghats, southwestern Maharashtra, India. *Rheedea* 22(1): 39–61

Matthew, K.M. (1982). *Illustrations on the flora of Tamilnadu and Carnatic - Volume 2*. The Rapinat Herbarium, St. Joseph's College, Tiruchirapalli, 883pp.

Mishra, D.K. & N.P. Singh (2001). *Endemic and Threatened Flowering Plants of Maharashtra*. Botanical Survey of India, Kolkata, 414pp.

Nayar, M.P. & A.R.K. Sastry (eds.) (1987–89). *Red Data Book of Indian Plants - Volume 1–3*. Botanical Survey of India, Calcutta, 908pp.

Ollier, C.D. & H.C. Sheth (2008). The high Deccan durricrusts of India and their significance for the laterite issue. *Journal of Earth Systematic Science* 117(5): 537–551.

Porembski, S. & A. Watve (2005). Remarks on the species composition of Ephemeral Flush Communities on paleotropical rock outcrops. *Phytocoenologia* 35(2&3): 389–401.

Porembski, S., U. Becker & R. Seine (2000). Islands on islands: habitats on Inselbergs. *Ecological Studies* 146: 49–67. In: Porembski, S. & W. Barthlott (eds.). *Inselbergs - Biotic Diversity of Isolated Rock Outcrops in Tropical and Temperate Regions*. Ecological studies 146. Springer, Heidelberg, 524pp.

Porembski, S., W. Barthlott, S. Dörrstock & N. Biedinger (1994). Vegetation of rock outcrops in Guinea: granite inselbergs, sandstone table mountains and ferricretes - remarks on species numbers and endemism. *Flora* 189: 315–326.

Rahangdale, S.S. (2008). Status of Floristic Diversity of Taluka Junnar, District Pune with special reference to impact of developmental activities. PhD Thesis. Agharkar Research Institute, Pune, University of Pune.

Rahangdale, S.S. & S.R. Rahangdale (2012). *Variety Novae* of *Ceropegia mahabalei* Hemadri et. Ansari [Apocynaceae: Asclepiadoideae]. *The Indian Forester* 138(2): 201–203.

Rahangdale, S.S., V.S. Ghate & S.R. Rahangdale (2009). New Report from Maharashtra: *Garnotia courtallensis* (Arn. & Nees.) Thw. *Rheedea* 19(1&2): 12.

Santapau, H. (1957). *The Flora of Purandhar.* Oxford Publication, Oxford, 158pp.

Santapau, H. (1960). The flora of Khandala on Western Ghats of India. *Records of Botanical Survey of India* 16(1): 1–369.

Santapau, H. & Z. Kapadia (1966). *The Orchids of Bombay.* Manager of Publication, Delhi, 239pp.

Sharma, B.D., S. Karthikeyan & N.P. Singh (eds.) (1996). *Flora of Maharashtra State, Monocotyledons.* Botanical Survey of India, Calcatta, 794pp.

Singh, N.P. & S. Karthikeyan (eds.) (2000). *Flora of Maharashtra State, Dicotyledons - Volume 1.* Botanical Survey of India, Calcatta, 898pp.

Singh, N.P., S. Lakshminarasimhan, S. Karthikeyan & P.V. Prasanna (eds.) (2001). *Flora of Maharashtra State, Dicotyledons - Volume 2.* Botanical Survey of India, Calcatta, 1080pp.

Watve, A. (2008). Rocky outcrops as special habitats in north Western Ghats, Maharashtra. In: Rawat, G.S. (ed.). *Special Habitats and Threatened Plants of India*. *ENVIS Bulletin: Wildlife and Protected Areas.* Wildlife Institute of India, Dehradun, 11(1): 147–153.

Watve, A. (2013). Status review of Rocky Plateaus in the northern Western Ghats and Konkan region of Maharashtra, India with recommendations for conservation and management. *Journal of Threatened Taxa* 5(5): 3935–3962. http://dx.doi.org/10.11609/JoTT.o3372.3935-62

Yadav, S.R., S.A. Chivalkar & K.V.C. Gosavi (2010). On the identity of *Jansenella griffithiana* (Poaceae) with a new species from Western Ghats, India. *Rheedea* 20(1): 38–43.