Forest and Restoration Opportunities in the Panshet Catchment

Vegetation character and species diversity of Panshet catchment

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Abstract

The present note elaborates the vegetation character and plant diversity in the Panshet Dam Catchment, studied during six months of field survey in 2014 (July-December) as part of a project undertaken by Ecological Society and supported by Global Forest Watch.

As floral species are directly related to climatic type, especially rainfall, therefore the Panshet catchment was divided into high, medium and low rainfall zones. The floral species survey was conducted in relation with these zones.

The focus of present study was to relate species composition with physical factors like altitude and climate. To study the vegetation character of the catchment, species level surveys of various vegetation categories like tall canopy forests, devrais, shrubbery and others, were undertaken and the species composition of each vegetation category was recorded. Moreover, species occurrence over rainfall zones was recorded. Identification of rare, endemic and specialist species was equally important to gauge the vegetation character and ecological value. Other observations included dominant species and invasive species.

Study Area : Panshet Dam Catchment

The Panshet dam is located near Panshet village at a distance of 45 km West of Pune city, Maharashtra, India. This dam impounds the water of river Ambi which originates in Western Ghats near a village Dapsar (Lat. N 18° 21" Long. E 73° 25") at an altitude of about 1200 MSL (Gole P., Tetali P., 1985).

The catchment area of 120.30 Sq. Km. encompasses a variety of land uses including village settlements, Devrais (Sacred Groves), shifting cultivation patches, dense shrubbery, scrubland, tall canopy, open grassland areas, exposed rock surfaces, riparian areas, monoculture stands, farm house schemes for urbanites, proposed townships, roads, agro industry and small industrial workshops (Ghate K., 2014). About 25 vil-

lages are scattered along both the sides of reservoir.

Within the Panshet catchment there are three rainfall zones - low, medium and high with average annual rainfall of 2000 to 3000 mm, 3000 to 6000 mm and 6000 to 9000 mm respectively (Ghate K., 2014). The rainfall drastically increases towards West of the dam as one travels towards the Western Ghats crestline.

These three rainfall zones provide different climatic conditions and create microclimates supporting specific vegetation type from moist deciduous to tropical semi-evergreen forest.

The Panshet Catchment area was studied by Ecological Society in 1985 for its status of animal and plant life with a focus on designing conservation plan

Diagram showing indicative rainfall zones in Panshet Catchment

(Ecological Society, 1985). The findings from this report about vegetation pattern and floral composition provided a baseline for the current survey.

Methodology used to document floral character and species diversity

A reconnaissance survey of the Panshet catchment was done and then sample sites were selected with the help of Google Earth images. A stratified random sampling approach was followed and 47 vegetation patches distributed across the three rainfall zones were identified for the survey (Karandikar M., Dumale V., Deshpande S., 2015). Among the 47 areas surveyed, 19 were in low rainfall zone, 15 in medium rainfall zone and 13 in high rainfall zone.

To study the flora of Panshet catchment, our team collected data about vegetation cover, species compo-

sition, occurrence, regeneration etc by Line Transect method. Observation of the landscape features was the base of the documentation. For this purpose, we recorded physical factors influencing vegetation like climate, altitude, slope, substratum (soil type and depth) and habitats.

The plant species were identified using Flora of Maharashtra, Botanical Survey of India (3 volumes) and The Flora of the presidency of Bombay by Theodore Cooke. The identified plant species were categorised as per habit, endemism (in Western Ghats and India), local rarity, presence in specific habitat (specialist¹ species) and IUCN (International Union for Conservation of Nature) status. The tree species were sorted as per their evergreen, deciduous and brevideciduous² nature while making the list. This species list was then used for further analysis.

Results and Discussion

The results of our species level survey are described and summarized below.

1. A total of 448 plant species were recorded within the Panshet Catchment which includes 131 species of trees, 75 species of shrubs, 70 species of climbers, 143 species of herbs, 23 species of grasses and 6 species of ferns.
2. A total of 100 families and 342 genera were recorded with the highest number of plants belonging to Leguminosae family followed by Poaceae and Apocynaceae families. The maximum number of species recorded belongs to Genus *Ficus* i.e. 11 species, followed by Genus *Acacia* and *Impatiens*.
3. The 448 plant species recorded include 425 native and 23 non-native species. The 425 native plant species include 74 endemic, 32 specialists, 21 locally rare and 3 IUCN listed species.
4. Among the 74 species of endemic plants, 13 are endemic to Western Ghats and 4 are endemic to Northern Western Ghats.
5. Table 1 shows the species diversity categorized on the criteria of endemism, habitat specialist/locally rare, following IUCN status. There are some striking observations regarding species peculiarity or pattern of species distribution and status of vegetation cover. The observations throw some light on the distributed ecology of the vegetation in the catchment.
6. The Panshet catchment area is broadly composed of Grasslands, Tropical moist-deciduous forest, Tropical semi-evergreen forest and Broad-leaved valley or ravine forests (Gole P., Tetali P., 1985).
7. It was observed that the low rainfall zone holds more of moist deciduous vegetation with prevalence of grasslands and degraded areas. The grassland and degraded areas are dominated with Kusali grass (*Heteropogon contortus*) associated with some herbaceous growth.
8. Impact of human interference is more prevalent near the dam wall. Hence, a higher level of degradation is seen in this area.
9. The high and medium rainfall zones hold tropical semi evergreen vegetation. Original tropical semi evergreen forests are seen to be relatively in good condition in sacred groves, a few riparian patches, few government forest patches and certain privately owned protected patches.
10. Some plant species were observed only in high rainfall zone, which includes tree species viz *Cassine paniculata*, *Diospyros sylvatica*, *Neolitsea zeylanica*, *Holigarna grahamii*, *Symplocos racemosa* and *Trichilia connaroides*; Shrub species viz *Abutilon persicum*, *Glycosmis pentaphylla*, *Rauvolfia verticillata* and the climber *Toddalia asiatica*. Steep slopes in this area are dominated by Karvi (*Carvia callosa*).
11. In the high rainfall zone of the Panshet catchment, Kasa tree (*Elaeocarpus glandulosus*) is rarely found while it is seen commonly in high rainfall areas elsewhere, like Panchgani. However one huge old growth tree of this species, located in Dapsar Village (high rainfall) was observed during study.
12. Some floral species were found in both the high and medium rainfall zones. These include trees species viz *Aglaiia lawii*, *Bombax insigne*, *Carallia brachiata*, *Celtis tetrandra*, *Ficus nervosa*, *Garcinia talbotii*, *Litsea ghatica*, *Memecylon talbotianum*, *Persea macrantha*, *Sapium insigne* and *Tetrameles nudiflora*. Shrub species of *Ixora nigricans*, *Maytenus rothiana*, *Nilgirianthus heyneanus* and *Thelepaepale ixiocephala* were found in these zones. Climbers found in these zones includes *Ancistrocladus heyneanus*, *Caesalpinia cucullata*, *Gnetum scandens*, *Pristimera grahamii*, *Argyreia involucrata*, *Clematis gouriana*, *Gymnema khandalense*, *Hoya wightii* and *Piper spp.*
13. In spite of heavy rainfall at the source of Ambi River, which is a crestline area of Western Ghats, comprised of cliffs and steep slopes, *Euphorbia sp.* was observed. It may be because of heavy rainfall causing soil erosion and physiological drought conditions on the rocky cliffs.
14. In the high rainfall area, the Ambi river hosts good riparian vegetation. The characteristics species of this zone are Umber (*Ficus racemosa*), Karanj (*Pongamia pinnata*) and Jambhul (*Syzygium cumini*) alongwith evergreen and brevi-deciduous tree species like *Chionanthus mala-elengi*, *Elaeocarpus glandulosus*, *Ficus hispida* etc.
15. Some species like *Litsea ghatica*, *Persea macrantha*, *Gymnema khandalens* were newly recorded as compared to the earlier survey of 1985.
16. An important highlight of this survey was the sighting of a climber, *Ceropegia huberi*. This is the first time it is being reported in the Panshet catchment. Its distribution is patchy and earlier it was reported only in Kolhapur (Gaganbawada), Ratnagiri (Amba Ghat), Satara (Vasota fort), and Pune (Tamhini). This species is endemic to Northern Western Ghats.

Table 1 : List of Endemic species of Panshet Catchment with IUCN status

Abbreviations and Terms :						
E – Evergreen, D – Deciduous						
BD – Brevideciduous						
IUCN - International Union for Conservation of Nature						
EN - Endangered; VU - Vulnerable						
NT - Near Threatened; LC - Least Concern						
S = Specialist species - Sensitive species requiring specific habitat. Such species may disappear if habitat is destroyed.						
R = Rare species - Species rarely found in Panshet catchment						

Sr. No.	Scientific name	Local name / Common name	E/D/BD	S/R	Endemism	IUCN Status
	TREES					
1	<i>Actinodaphne angustifolia</i>	Pisa	E		Endemic to Western ghats	
2	<i>Aglaia lawii</i>	...	E		Endemic to Western ghats	
3	<i>Bombax insigne</i>	Devsavar	BD	R		
4	<i>Bridelia retusa</i>	Asana	BD		Endemic to India	
5	<i>Carallia brachiata</i>	Phanshi	E	R		
6	<i>Cassine paniculata</i>	Bhutya (Thikra)	E	S		
7	<i>Celtis tetrandra</i>	Brumaj	BD	R		
8	<i>Celtis timorensis</i>		BD	R		
9	<i>Dalbergia sissoo</i>	Sisoo	D			VU
10	<i>Dimocarpus longan</i>	Umb	E	S		
11	<i>Dimorphocalyx lawianus</i>	Jodpakli	E	S	Endemic to Western ghats	NT
12	<i>Diospyros sylvatica</i>		E	S		
13	<i>Elaeocarpus glandulosus</i>	Kasa	E	S		
14	<i>Ficus nervosa</i>	Loth	E	S		
15	<i>Flacourtia latifolia</i>	Taambat	D		Endemic to India	
16	<i>Garcinia talbotii</i>	Phansada	E	S	Endemic to Western ghats	
17	<i>Glochidion ellipticum</i>	Bhoma	E		Endemic to Western ghats	
18	<i>Holigarna grahamii</i>	Raan biba	E	S	Endemic to Western ghats	

Sr. No.	Scientific name	Local name / Common name	E/D/BD	S/R	Endemism	IUCN Status
19	<i>Hymenodictyon obovatum</i>	Kadva sirid	BD		Endemic to India	
20	<i>Lagerstroemia microcarpa</i>	Nana	D		Endemic to India	
21	<i>Litsea ghatica</i>		E	S		
22	<i>Mallotus aureopunctatus</i>		E	S	Endemic to Western ghats	
23	<i>Memecylon talbotianum</i>		E	S	Endemic to Western ghats	
24	<i>Neolitsea zeylanica</i>		E	S		
25	<i>Persea macrantha</i>	Gulum	E	S		
26	<i>Phoenix loureiroi</i> var. <i>pedunculata</i> / <i>Phoenix robusta</i>	Shelu	E	R	Endemic to India	
27	<i>Sapium insigne</i> / <i>Falconeria insignis</i>	Hura	D			VU
28	<i>Sterculia guttata</i>	Kukar	BD	R		
29	<i>Symplocos racemosa</i>		E	S		
30	<i>Terminalia paniculata</i>	Kindal	BD		Endemic to India	
31	<i>Tetrameles nudiflora</i>		BD	R		
32	<i>Trichilia connaroides</i>	Limbara	E	R		
33	<i>Xylia xylocarpa</i>	Zambha	D	R		
	SHRUBS					
34	<i>Abutilon persicum</i>	Madam		R		
35	<i>Agrostistachys indica</i>	Agasti		R		
36	<i>Anisomeles heyneana</i>	Gopali			Endemic to India	
37	<i>Artemisia nilagirica</i>	Dhor Davana			Endemic to India	
38	<i>Cajanus lineatus</i>	Ran tur			Endemic to India	
39	<i>Calacanthus grandiflorus</i>			R	Endemic to India	
40	<i>Capparis parviflora</i>	Kabar		S		
41	<i>Carvia callosa</i> / <i>Strobilanthes callosus</i>	Karwi			Endemic to India	
42	<i>Cissus woodrowii</i>	Girnul			Endemic to India	
43	<i>Desmodium laxiflorum</i>	Asud		R		

Sr. No.	Scientific name	Local name / Common name	E/D/BD	S/R	Endemism	IUCN Status
44	<i>Ecbolium ligustrinum</i>	Hirvi aboli		R		
45	<i>Glycosmis pentaphylla</i>	Kirmira / Maenaki(Ban Limbu)		S	Endemic to India	
46	<i>Ixora brachiata</i>	Gorbale	E		Endemic to Western ghats	
47	<i>Ixora nigricans</i>			S		
48	<i>Maytenus rothiana/</i> <i>Gymnosporia rothiana</i>	Bhalwand			Endemic to Western ghats	
49	<i>Nilgirianthus heyneanus</i>	Akra			Endemic to India	
50	<i>Rauvolfia verticillata</i>	Alpagandha		R		
51	<i>Thelepaepale ixiocephala</i>	Patri			Endemic to India	
52	<i>Calamus pseudotenuis</i>	Vet		S		
	HERBS					
53	<i>Adelocaryum coelestinum/</i> <i>Paracaryopsis coelestina</i>	Nisurdi			Endemic to India	
54	<i>Aeginetia indica</i>			S		
55	<i>Aerides crispum /</i> <i>Aerides crispa</i>	Panshing		S	Endemic to Western ghats	
56	<i>Aerides maculosum</i>				Endemic to peninsular India	
57	<i>Asystasia dalzelliana</i>	Neelkanth			Endemic to India	
58	<i>Balanophora abbreviata</i>	Alimbi bandgul		S		
59	<i>Begonia crenata</i>	Kapru			Endemic to India	
60	<i>Chlorophytum glaucum</i>				Endemic to India	
61	<i>Crinum latifolium</i>	Gulabi karnaful		R		
62	<i>Crotalaria filipes var. filipes</i>	Phatphati			Endemic to India	
63	<i>Curcuma caulina /</i> <i>Hitchenia caulina</i>	Chavar		S	Endemic to Northern Western Ghats	
64	<i>Curcuma pseudomontana</i>	Raanhalad			Endemic to India	
65	<i>Cynarospermum asperrimum</i>	Dikna			Endemic to India	
66	<i>Desmodium ritchiei</i>				Endemic to India	
67	<i>Ensete superbum</i>	Rankeli			Endemic to India	
68	<i>Eranthemum roseum</i>	Dashmuli			Endemic to India	
69	<i>Eria dalzellii</i>			R	Endemic to Western Ghats	

Sr. No.	Scientific name	Local name / Common name	E/D/BD	S/R	Endemism	IUCN Status
70	<i>Exacum lawii</i>	Lahan chirayat			Endemic to India	
71	<i>Exacum pumilum</i>	Jambhli chirayat			Endemic to India	
72	<i>Geissaspis tenella</i>	Lahan barki			Endemic to India	
73	<i>Habenaria grandifloriformis</i>				Endemic to Western Ghats	
74	<i>Habenaria longicorniculata</i>				Endemic to Peninsular India	
75	<i>Haplanthodes verticillatus</i>	Jakara			Endemic to India	
76	<i>Hemigraphis latebrosa</i>	Morpankhi			Endemic to India	
77	<i>Impatiens acaulis</i>				Endemic to India	
78	<i>Impatiens minor</i>				Endemic to India	
79	<i>Impatiens pulcherrima</i>	Dhal - Terda			Endemic to India	
80	<i>Kalanchoe olivacea</i>	Paanphuti			Endemic to India	
81	<i>Lavandula gibsonii</i>				Endemic to India	
82	<i>Malaxis rheedii</i>	Mala amri		S		
83	<i>Pecteilis gigantea</i>	Waghchora		S		
84	<i>Phyllocephalum tenue</i>	Parnagumphi			Endemic to India	
85	<i>Pimpinella adscendens</i>				Endemic to India	
86	<i>Pinda concanensis</i>	Panda/Pinda			Endemic to Northern Western Ghats	
87	<i>Rhamphicarpa fistulosa</i> / <i>R. longiflora</i>	Tutari			Endemic to India	
88	<i>Senecio bombayensis</i>	Sonki			Endemic to India	
89	<i>Smithia bigemina</i>	Kawla			Endemic to India	
90	<i>Smithia hirsuta</i>				Endemic to India	
91	<i>Smithia purpurea</i>	Barka			Endemic to India	
92	<i>Swertia minor</i>				Endemic to India	
93	<i>Tectaria cicutaria</i>	Kombadnakhi		R		
94	<i>Trachyspermum roxburghianum</i>	Pinela			Endemic to India	
95	<i>Zingiber neesatum</i>	Nisam			Endemic to India	
	CLIMBERS					
96	<i>Ancistrocladus heyneanus</i>	Kardal		S	Endemic to India	
97	<i>Dalbergia horrida</i> var. <i>horrida</i>	Pedgul			Endemic to India	

Sr. No.	Scientific name	Local name / Common name	E/D/ BD	S/R	Endemism	IUCN Status
98	<i>Caesalpinia cucullata</i>	Ragi		R		
99	<i>Gnetum scandens</i>	Umbli		S		
100	<i>Pristimera grahamii</i> / <i>Hippocratea grahamii</i>	Lokhandi/daushir		S		
101	<i>Argyreia involucrata</i>				Endemic to India	
102	<i>Argyreia sericea</i>	Gavel			Endemic to India	
103	<i>Asparagus racemosus</i>	Shatavari			Endemic to India	
104	<i>Ceropegia huberi</i>				Endemic to northern Western Ghats	
105	<i>Ceropegia oculata</i>	Mor kharchudi			Endemic to India	
106	<i>Clematis heynei</i>	Raanjai			Endemic to India	
107	<i>Cynanchum tunicatum</i>	Panchali		R		
108	<i>Dioscorea belophylla</i>			R	Endemic to India	
109	<i>Entada rheedii</i>	Garambi		S		
110	<i>Gymnema khandalense</i> / <i>Bidaria khandalense</i>			S	Endemic to Northern Western Ghats	
111	<i>Hoya wightii</i>	Ambari		S	Endemic to India	
112	<i>Jasminum malabaricum</i>	Kusar			Endemic to India	
113	<i>Piper spp.</i>			S		
114	<i>Toddalia asiatica</i>	Jungli mirchi		S		

Note: Above list is a result of 6 months survey and more species may get recorded with a detailed multi-season survey.

Table 2 : Floral composition observed in rainfall zones

Rainfall Zone	Average annual rainfall	Floral Composition
Low	2000 to 3000 mm	Terminalia- Bridelia – Mangifera
Medium	3000 to 6000 mm	Actinodaphne –Terminalia- Albizia
High	6000 to 9000 mm	Memecylon- Olea- Syzygium

Note: This composition is as per the data collection and observations done by the team in catchment. Quadrat sampling was not done.

Table 3- Distribution of sacred groves in rainfall zones

Low rainfall zone	Medium rainfall Zone	High Rainfall Zone
1. Viroba SG, Ambegaon 2. Bhairi SG, Ambegaon 3. Talawati SG, Ambegaon 4. Pandharphali SG, Vanjarwadi 5. Kalkai SG, Vanjarwadi 6. Kalkai SG, Giwashi 7. Jagoba SG, Giwashi	1. Vardaini SG, Gondekhal 2. Somjai SG, Gondekhal 3. Janani SG, Mangaon 4. Shirkai SG, Shirkoli	1. Unnamed SG, Kurtawadi 2. Vardaini SG, Kurtawadi 3. Jakhin and Kalkai SG, Dapsar 4. Kuthar SG, Dapsar 5. Shambhoji SG, Dapsar 6. Somjai SG, Dapsar 7. Mulai SG, Dapsar 8. Kalkai SG, Tekpovale 9. Vardaini SG, Tekpovale

Note: SG – Sacred Grove

17. The whole catchment area is dotted with sacred groves. They differ in size. The highest number of sacred groves was observed in high rainfall zone. The Mangaon Sacred Grove in medium rainfall zone is the largest sacred grove with an area of about 16 ha. (Table 3)
18. People cultivate *Dendrocalamus* species of Bamboo around their villages for economic reasons (Gole P., Tetali P., 1985). A naturally growing bamboo species, Kalak (*Bambusa arundinacea*) was observed in the high rainfall zone.
19. In spite of the timber value, the locals preserved mango trees since the fruits offer sustainable income for them. Due to this, the dominant vegetation in the low and medium rainfall zones consists of mango trees.
20. In the high rainfall zone, one of the characteristic components of vegetation is Lianas. Species like Umbali (*Gnetum scandens*), Kardal (*Ancistrocladus heyneanus*), Watoli (*Diploclisia glaucescens*), along with Garambi (*Entada rheedii*) were found in good canopy patches.
21. Liana of Garambi (*Entada rheedii*) is found throughout the catchment. In the low rainfall zone, it is found only in sacred groves, probably because of suitable conditions of moisture. In the high rainfall zone, it is more common and found even along the roads, covering trees and creating dense canopy.
22. Relative to 1985, shifting cultivation practices have now declined. The abandoned shifting cultivation patches are now covered with dense shrubbery and show growth of woody and hardy species like Karwand (*Carissa congesta*), Dhayati (*Woodfordia fruticosa*) along with tree species like Ain (*Terminalia tomentosa*), Kumbha (*Careya arborea*), Asana (*Bridelia retusa*) etc. Good regeneration of plant species was observed in all three rainfall zones.
23. Plantations of non-native species like Gliricidia and Australian Acacia were observed on large scale in the vicinity of the dam wall, near the reservoir and on hill slopes throughout the catchment.
24. Wild vegetation provides food for local people e.g. Kartoli (*Momordica dioica*), Takala (*Cassia tora*), Kurdu (*Celosia argentea*) and fruits of Karvanda (*Carissa congesta*), Alu (*Meyna laxiflora*), Mango (*Mangifera indica*) etc.
25. Presence of weeds was very common along the roads, fringe areas of sacred groves, open areas, periphery of agricultural land and settlements. Invasive species like *Cosmos*, *Eupatorium*, *Parthenium*, *Alternanthera*, *Lantana* etc. were found throughout the catchment.

Conclusions

1. The occurrence of some specialist plants in dense vegetation patches outside sacred groves highlights the need of conserving these vegetation patches for conservation of catchment area vegetation and maintaining habitat continuity in the area.
2. The sacred groves harbor higher number of specialist and endemic species and need to be conserved with high priority.
3. Even in the low rainfall zone, if protection is provided, species like *Ceropegia bulbosa* and *Ceropegia oculata* are seen regenerating. This observation was made in the plot where Ecological

Representative Photographs of Survey areas and plant species

Ceropegia huberi, climber endemic to Northern Western Ghats

Habenaria longicorniculata

Holigarna grahamii (Ran bibba), tree found only in high rainfall zone

Symplocos racemosa, tree found only in high rainfall zone

Ceropegia occulata

Dimorphocalyx lawianus (Jodpakali), tree endemic to Western Ghats

Open grassland in Ambegaon Khurd village

Kuthar sacred grove

Shrubbery

Tall canopy

Society has carried out ecological restoration for the past several years.

4. The previous ecological survey of Ecological Society pertaining to the Panshet catchment dates back to 1985 i.e. more than 30 years ago. The present detailed survey was conducted in 2014, though only for six months; therefore the extensive survey and further studies of the vegetation in Panshet catchment are needed.
5. Looking at the vegetation composition of mature forest including sacred groves, high endemism was observed in the high rainfall zone near crestline. Several streams and river Ambi originate in this area. Therefore this area has a high conservation value.
6. There is an urgent need to protect the following rare and specialist species otherwise they will become locally extinct due to continued degradation and land use change: *Ancistrocladus heyneanus*, *Ceropegia huberi*, *Elaeocarpus glandulosus*, *Garcinia talbotii*, *Cassine paniculata* etc.
7. The association between flora and fauna highlights the importance of preserving various types of forests. e.g. The Malabar Giant Squirrel is associated with continuous canopy seen in sacred groves.
8. There are several threats to sacred groves like cattle grazing, tree cutting, transport through grove, temple construction inside the grove, road construction, presence of adjacent private land and construction projects coming up in vicinity etc. Sacred groves being old mature forests of great biological value, these issues must be prioritised.

References

An Enquiry into the Status of animal and plant life in critical areas of Western Ghats in order to evolve plan to conserve their biological diversity, Ecological Society, Pune, Vol I and II, 1985.

Report of Ecological Survey undertaken in Panshet Catchment and Bhimashankar Wildlife Sanctuary under Small Grants Program, Global Forest Watch, Ecological Society, Pune, India, April 10, 2015.

The Sacred Groves of Western Ghats in India, Gadgil M. and Vartak V., Economic Botany, 1976.

Changes in Ecological Landscape Pattern and Land Use from 1985 to 2014 in the Panshet Dam Catchment, Karandikar M., Dumale V., Deshpande S., Journal of Ecological Society, Volume 28, 2015.

Management of Forests in Northern Western Ghats, Ghate K., Journal of Ecological Society, Volume 26 – 27, 2014.

Flora of Maharashtra State (Dicotyledones), Volume 1, Editors N. P. Singh, S. Karthikeyan, P. Lakshminarasimhan and P. V. Prasanna, Botanical Survey of India, 2000

Flora of Maharashtra State (Dicotyledones), Volume 2, Editors N. P. Singh, P. Lakshminarasimhan, S. Karthikeyan and P. V. Prasanna, Botanical Survey of India, 2001

Endemic and Threatened Flowering Plants of Maharashtra, Dipak Kumar Mishra and N. P. Singh, Botanical Survey of India, 2001

The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on 31 January 2015.)

http://wgbis.ces.iisc.ernet.in/biodiversity/database_new/?q=node/35

<http://www.ifpindia.org/content/mapping-tree-endemism-western-ghats>

Endnotes

1. Specialist species is a species having specific habitat requirement and it occurs as remnant of original (primary) forest, whereas generalist species can occupy a variety of habitats including degraded.
2. Brevidiciduous trees show brief loss of leaves just prior to flowering or before new leaf growth.