

REVIEW ARTICLE

## Floristic studies on hill forts of Sahyadri: A review

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**Abstract:** Forts are one of the key features of Northern Western Ghats and provide a diverse range of habitats due to their unique topography and act as shelter places for native and endemic flora. They play important role in their respective ecosystems as they protect and isolate flora and fauna resulting into home for numerous endemic species. Floristics of forts have been studied by various workers and in present review, an effort has been made to present detailed account of floristic studies on forts in Sahyadri ranges of Western Ghats.

**Keywords:** Floristics, Forts, Maharashtra, Western Ghats

### Western ghats

India is among one of the 17 mega diverse countries in the world. Indo-Burma, Himalaya, Western Ghats, and Sundaland are the four biodiversity hotspots in India. Because of its diverse habitat and climatic circumstances, India has a wealth of biological resources (Venkataraman and Sivaperuman 2018). Western Ghats of India is one of the hottest biodiversity hotspots in the world (Mittermeier *et al.* 2004). The Western Ghats ranges run north-south to Deccan plateau, and form the western edge of the plateau (Watve 2010). It stretches for 1600 kilometers along India's west coast, encompassing 140,000 square kilometers area. Despite covering less than 6% of India's land surface, the Western Ghats are home to more than 30% of the country's plant, fish, herpetofauna, bird, and mammal species. It possesses relatively high amount of endemic species (Bawa *et al.* 2007). This region comprises 8,080 flowering plant taxa including 7,402 species, 117 subspecies and 476 varieties. There are 5,588 indigenous species present in Western Ghats, out of which 2,253 species are endemic to India and 1,273 species are exclusively endemic to Western Ghats (Nayar *et al.* 2014).

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### Northern western ghats (Sahyadri)

The Northern Western Ghats, also called as Sahyadri, run north-south and are about 750 km long and 80 km wide, with an average height of 800-1650 m above mean sea level (Tambade *et al.* 2016). The Sahyadri range stretches from 72° 61' to 74° 40'E to 15° 60' to 20° 75' N, starting from Daman up to the Terekhol creek, having total area of 52,000 km<sup>2</sup> in Maharashtra. Sahyadri is highly forested due to high precipitation i.e., 250-440 cm in monsoon (Singh and Karthikeyan 2000). There are 350 forts present in Maharashtra, out of which 250 forts are hilly and nested in Sahyadri. A large plateau on the hilltop of Sahyadri is one of the distinctive feature which were converted into famous hill-forts in the past times (Muley 2015).

### Topography of forts

Sahyadri mountain range in Maharashtra state is significant because of the construction of many 'Durg', also called 'fort'. These forts have been built as a defense against hostile neighbors. Diddee *et al.* (2002) have described the general geology of the northern section of Western Ghats. The region's geomorphology is shaped by the tectonic activity of peninsular India, which is influenced by litho-structural and climatic factors. Deep ravines and canyons can be found on the western side of Sahyadri, whereas flat-topped spurs pierced by valleys can be seen on the eastern side. The typical

trappean flat-topped hills may be found at forts like Rajgad, Raigad, Purandar, Harischandragad, and others. A peculiar feature of the Northern Western Ghats is the presence of numerous barren, stony, rocky plateaus called locally as 'sadas.' It supports ephemeral flush vegetation, which contains monotypic and endemic plants, most of which have a very limited distribution. Rocky plateaus can be primarily divided on the basis of substrate as the lateritic plateaus and the basaltic plateaus (Bharucha *et al.* 2010, Subramanyam and Nayar 1974, Diddee *et al.* 2002, Watve 2010).

## Floristic work on forts

### India

Durg is derived from the Sanskrit word '*durgam*', which means inaccessible. The term 'Fort' is derived from the French word '*fortis*', which means "strong" (Muley 2015). Forts attracted researchers, due to their rich biodiversity wealth. But because of their inaccessible areas, the comprehensive floristic work on forts is not done. Some general floristic works have been done in India. But most of the forts are neglected from the floristic and ecological point of view.

Some of recent floristic work on forts in India is done by Sukumaran and Parthiban (2014) who reported 346 plants species, belonged to 265 genera and 90 families from the Udayagiri fort, Kanyakumari district, Tamil Nadu. Babita and Sharma (2014) reported 122 species during study of plant diversity of Fort Khetri and surrounding, from Rajasthan. Bhat *et al.* (2016) assessed diversity of tree species on Gwalior Fort, Madhya Pradesh. In their study, they encountered total of 2165 trees belonging to 51 species, 46 genera and 24 families. Shrishail and Prashantkumar (2019) worked on Gulbarga fort in Karnataka. They studied epilithophytes of fort and observed 59 species of plants under 47 genera belong to 22 families on the walls of Gulbarga fort. Shrishail *et al.* (2020) reported 158 plant species belonging to 39 families of Angiosperms, 4 species of Pteridophytes, 3 species of Bryophytes, 4 species of Algae from the rocks and fort walls and ponds of Raichur fort.

### Sahyadri

Hooker (1872-1897) published *Flora of*

*British India* in seven volumes. Dalzell and Gibson (1861) prepared short descriptions of plant into their *Flora of Bombay*. Birdwood (1887) published *Catalogue of the Flora of Matheran and Mahabaleshwar*. Cooke (1901-1908) studied the plants of the Bombay Presidency and published *The Flora of Presidency of Bombay* in 3 volumes. Nairne (1894) studied Concan and Deccan and published, *The flowering plants of western India*. Talbot (1894) published *Systematic list of the tree, shrubs and woody climbers of the Bombay Presidency*. Santapau (1953) studied, *The flora of Khandala on the western ghats of India*.

Kamble and Pradhan (1988) reported 651 taxa in the *Flora of Akola district*. Ugemuge (1986) studied *Flora of Nagpur district* and reported nearly 1163 species. Kulkarni (1988) published *Flora of Sindhudurg district* and reported 1123 taxa. Almeida (1990) published *Flora of Savantwadi* which includes ca 1685 vascular plants. Lakshminarasimhan and Sharma (1991) recorded 952 taxa in *Flora of Nasik district*. In *Flora of Raigad district*, Kothari and Moorthy (1993) enumerated 1248 taxa. Sharma *et al.* (1996) published *Flora of Maharashtra State: Monocotyledons*, which reports 34 families, 956 genera, 904 species, 2 subspecies, 39 varieties, 1 sub variety and 1 form of wild plants. Singh and Karthikeyan (2000) and Singh *et al.* (2001) published *Flora of Maharashtra State: Dicotyledons*, including 153 families, 832 genera, 2123 species, 18 subspecies and 107 varieties. Naik (1998) described 1718 taxa of flowering plants in the *Flora of Marathwada*. Diwakar and Sharma (2000), in their *Flora of Buldhana district* reported 584 taxa. Yadav and Saradesai (2002) reported 2227 species, 5 subspecies, 30 varieties belonging to 1023 genera and 182 families of flowering plants in *Flora of Kolhapur District*. Mishra and Singh (2001) enumerated *Endemic and threatened flowering plants of Maharashtra* in which they have reported 690 endemic and threatened taxa. Potdar *et al.* (2012) published *Grasses of Maharashtra* in which they recorded 415 species of grasses belonging to 120 genera. Wadoodkhan (2015) published *Cyperaceae of Western Ghats, West Coast and Maharashtra*, and reported 16 genera and about 322 species and 84 infraspecific taxa of Cyperaceae.

Different forts show different vegetation

due to their difference in location (Mungikar 2011). Because of their inaccessible area, rare species have been preserved in canyons and trenches, ledges and chinks of forts. Many ferns, liverworts, and mosses grow on fort walls (Singh and Karthikeyan 2000). Hill forts should be recognized as local biodiversity hotspots while prioritizing conservation areas in the Northern Western Ghats, and all micro habitats, natural and man-made, should be protected for the protection of Western Ghats endemic and vulnerable species, as well as local endemics in Northern Western Ghats (Datar and Tetali 2019).

Various researchers worked on the floristics of forts. Due to their construction on the peculiar location on the Sahyadri ranges, they are not easily accessible. Therefore, the floristic work on the forts of Sahyadri is limited (Singh and Karthikeyan 2000). Santapau (1951) worked on floristic studies of Sinhgad fort. In 1958, he published '*Flora of Purandhar*' with report of 683 species of plant belonging to 101 families. Vartak (1953, 1965) explored forts like Torana and Raigad. They reported 241 species from Torana Fort. Billore and Hemadri (1972) studied vegetation on Harischandragad, in which 330 species comprising 245 genera, representing 87 families of angiosperms have been enumerated. Floristic studies of Vasota and its surroundings is done by Bachulkar-Cholekar (1996). He recorded 1452 species of flowering plants belonging to 680 genera and 156 families. Yadav and Sardesai (2002) in their Flora of Kolhapur, mentioned historical and botanical interest of Bhudargad, Gagangad, Panhala, Pargad, Rangana, Samangad and Vishalgad Forts. Cerejo *et al.* (2010) studied Chasmophytic flora of Bassein fort or Vasai fort, in which they reported 102 species belonging to 82 genera from 42 families. Mungikar (2011) studied vegetation of forts across the Western Maharashtra, and in their study area 12 forts were accessed in which they have reported 672 angiospermic species, 440 genera and 124 families. Kulkarni *et al.* (2015) assessed tree species diversity on Lohgad and Visapur Fort in which 194 tree species belonging to 134 genera and 48 families were recorded. Floristic studied of Torana fort is done by Nandikar *et al.* (2018) and reported a total of 399 angiosperm species which comprised 274 genera and 73 families. Jadhav (2021) has done floristic study of Galana Fort area, recording 56 families, 114 genera and 141 species of the plants. Wagh,

Sonawane and Deore (2018) studied vegetation around Salher Mulher. Datar and Tetali (2019) described the importance of hill forts as they are shelter house for many endemic plants.

### Ethanobotanical work on forts

Shinde *et al.* (2018) has studied ethanobotanical plant species used by tribal people from Ankai fort of Yeola Tehsil of Nasik district. Soman (2014) did ethanobotanical studies of plants from Panhala and surrounding area. Jadhav *et al.* (2011) mentioned some wild edible plants from Panhala. Bhosale *et al.* (2009) enumerated some ethanobotanical plants from Puranadhar fort.

### Endemism and novelties from forts

Gradual changes in abiotic factors generate environmental gradients, which affect species abundances and distributions and are vital for the spatial distribution of biodiversity (Naud *et al.* 2019). Various ecological gradients can be found in the Sahyadri forts. Plants adapt to these flat-topped forts in a variety of conditions, from heavy rainfall to dry summers. Survival in these forts could not be possible without this adaptation in the plants. This resulted in the emergence of numerous endemic species in the area. The plateau ecosystem, which is rich in flora, is protected by forts. Threatened species such as *Frerea indica* have only been found in hill forts such as Purandar, Shivaneri, and Sajjangad. *Thalictrum dalzellii* Hook., *Delphinium malabaricum* (Huth) Munz, *Ceropegia maccannii* Ansari, *Ceropegia sahyadrica* Ansari and B. G. Kulk., and many others are found in the forts. Many species, including *Pimpinella rollae* Billore and Hemadri and *Flemingia rollae* (Billore and Hemadri) An.Kumar, were initially collected and described from Harishchandragad forts. The first collection of *Eriocaulon tuberiferum* A.R.Kulk. & Desai came from Panhala Fort. Other species found in Sahyadri hill forts include *Indigofera santapau* Sanjappa, *Indigofera trita* L. var. *purandharensis* Sanj., *Neanotis sahyadrica* Billore and Mudliar, and *Rhamnus purandharensis* Bhandari and Bhansali., *Cynanchum sahyadricum* (Ansari and Hemadri) Liede & Khanum (= *Seshagiria sahyadrica* Ansari and Hemadri) was described for the first time from fort. Some species described from fort are restricted to their type locality only. *Fimbristylis ambavanensis* V.P. Prasad &

N.P.Singh is found in monsoon puddles of hill fort Korigad (Datar and Tetali 2019).

Yadav *et al.* (2009) discovered new species of *Eleocharis* from tableland nearby Panhala Fort. Nampy *et al.* (2012) described *Murdannia sahyadrica* A. Ancy and Nampy from Sinhagad fort. Pethe and Tillu (2016) reported the highly threatened *Ceropegia mahabalei* Hemadri and Ansari from Ramshej Fort of Nashik. Jalal and Jayanthi (2019) described *Pecteilis korigadensis*, a new species of orchid from Korigad Fort. Prabhukumar *et al.* (2019) described *Barleria sahyadrica* K.M.P. Kumar & Sardesai, a new species from Panhala Fort of Kolhapur District. More, Conti and Bhosale (2020) recently described a new species *Echinops sahyadricus* collected from Rajgad, and also found on Hatgad, Salher, Torna, Purandar, Sajjangad and Ajinkyatara forts. Dhabak *et al.* (2021) rediscovered *Croton gibsonianus* Nimmo in Addenda, an endemic of northern Western Ghats of Maharashtra from Harishchandragad after 170 years.

## Conclusion

Hilly forts in Northern Western Ghats have, by virtue of their formation and unique topography, evolved into an exceptional habitat supporting endemic and RET plant species. So many novelties have been described from the hill forts of Sahyadri. There are several reasons which causes lowering of plant resources viz. Tourism, deforestation, hunting, over grazing, forest-fire etc. Increase in Human civilization on the fort since last few decades is the main reason of the degradation of overall indigenous biodiversity of the forts and increase in exotic plant species.

Documentation of plant resources on the forts in Northern Western Ghats are not yet been done thoroughly, so there is need of floristic studies of forts along with ecological aspects. The outcome of plant diversity analysis of the forts will be prime work and form basis for policy makers, forest officials, researchers and local inhabitants in sustainable utilization of plant resources. These are our cultural and natural footprint of our ancestors, which needs to be conserved for thousands of years.

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