



21.0 Rocky Outcrops as Special Habitats in North Western Ghats, Maharashtra

Aparna Watve

34/6, Gulawani Maharaj Rd, Pune 411 004, Maharashtra
aparnawatve1@gmail.com

Introduction

“Rock outcrops” is the term used for habitats where portions of freely exposed bedrock protrude above the soil level due to natural reasons. Rocks exposed due to human activities such as deforestation are not included in this habitat category. Cliffs, isolated hills and platforms of rocks formed due to landscape level activities of weathering are the types of outcrops seen commonly in India. Well known rock outcrops habitats in the world are inselbergs, barrens, cedar glades, cliffs, serpentine, ultramafic, limestone and gypsum outcrops. Each of which is known to harbour highly specialized vegetation rich in habitat specific and endemic plants.

Rock outcrop habitats are generally of small extent within a region and present particular habitat limitations *e.g.*, exposure to sun and lack of soil. The microenvironment at the rock surface ranges from very hot and arid in dry season to water logged in the wet season. Hence edaphically controlled herbaceous plant communities are characteristic of rock outcrops. On an outcrop a variety of microhabitat types have been recognized such as seasonal rock pools, ephemeral flush communities, shallow depressions, boulders, crevices, *etc.* Owing to the diversity of microhabitats, rock outcrop are actually “habitat complexes” sheltering a diversity of plant groups ranging from succulents to hydrophytes within a relatively small area. Extreme microenvironmental conditions present on the outcrops differ widely from the surrounding mesic areas and hence they function as terrestrial habitat islands. In many regions of Africa, America and Australia, it has resulted in the formation of narrowly endemic species which are adapted to the microclimatic conditions of the outcrops and cannot thrive elsewhere.

In India, the habitat is represented in many ways. Large monolithic inselbergs and koppjes are common in South India. Cliffs are dominant outcrop type in the mountainous regions. Rocky plateaus of basalt and laterite present in Western Maharashtra (between 16°-19° N latitude), are of high botanical value due to presence of endemic plants (Plates 21A & 21B). In spite of western Maharashtra being floristically well studied and rich in endemic species, scant information is available about the general ecology and diversity of vegetation of these outcrops.

The lateritic outcrops are indurated rocky plateaus of laterite, known as duricrusts or ferricretes. These are formed around 65m years ago, due to chemical leaching of the parent rock in high rainfall conditions followed by hardening leading to formation of laterite, a red coloured stone rich in iron and aluminium. Lateritic outcrops (known as ‘*sadas*’ in Marathi) can be divided into high level laterites located between 800-1200m asl in the Western Ghats and low level laterites located below 100m asl in the Konkan region. They occur between 16°-18° N in Maharashtra. The outcrops of basalt are exposed on flat topped hills of the northern Western Ghats and are more common at the northern tip of the Western Ghats, between 18° - 21° N. All the outcrops are widely separated from each other by highly weathered landscape, predominantly covered by woody vegetation, and thus exist as “*terrestrial island habitats*”.

Soil formation on the outcrops is extremely slow. Soil depth varies from a few centimeters on flat areas to about a meter in deep cracks and depressions. It is sandy to sandy loam in texture, highly acidic and poor in phosphates. In the dry period, the temperature of exposed rock surface is very high (maximum recorded 58°C) and humidity is very low (lowest recorded 14%). In the monsoon, conditions go to other extreme when the rains are continuous and heavy from July to September, leading to formation of ephemeral wetlands. Scarcity of soil and extremes of microclimate are



unfavourable for the growth of perennial vegetation. Hence, vegetation dominated by annuals thrives on outcrops only in moist conditions. Following vegetation types can be categorized on these outcrops. The microhabitat categories follow Porembski *et al.* (1998) with some modifications.

Vegetation of rock surfaces

Cryptogamic vegetation of rock surfaces [R] :

Exposed rock surfaces on laterite as well as basalt are completely covered by cyanobacterial crust and some crustose and foliose lichens. Immediately after the onset of monsoon, the rocks become slippery due to the slimy sheaths of the cyanobacteria.

Cryptogamic vegetation of boulders [B] :

Boulders of different sizes up to a meter in height occur often on the outcrop surfaces. On some lateritic plateaus, the entire surface is covered by loose boulders which make it look like rock field. The boulders are also covered by cyanobacterial crust, and have other species according to the available surface, crags and height of the boulders. Moss cushions and ferns including desiccation tolerant *Cheilanthes* sp. are frequent on the boulders. Lithophytic orchids such as *Eria* find this a suitable place for growth.

Vegetation of rock crevices [CR] :

Crevices in rocks provide opportunities for establishment of the plants. Depending upon the depth and width, they can be small or large. Small crevices are very common on the outcrops and provide safe growing sites for mosses, ferns and some angiosperms like *Flemingia neilgherensis*.

Vegetation of depressions:

Vegetation of ephemeral pools [SRP] :

c1.1. Shallow pools are commonly formed in places where water accumulates after flowing over a gently sloping area. They have gently sloping sides, little accumulated soil at bottom and about 2-5cm depth of water. Shallow pools on lateritic plateaus of the Western Ghats are habitats of rare *Ericaulon tuberiferum* and *Aponogeton saterensis*.

c1.2. Deep pools are more common on the basaltic outcrops. They form in large potholes, with well defined and almost vertical rocky edges, have 10cm or more water depth and often have a few cm of soil accumulated at the bottom of the pothole. Some of the deep pools can be more than 1m deep and retain some water in the deepest part almost through the year.

Soil filled depressions: Soil filled depressions occur where rock is relatively flat and soil and humus have accumulated over the years.

Ephemeral flush vegetation [EFV] :

The term ephemeral flush vegetation (EFV) is a special type of vegetation that grows on rocky areas where water slowly seeps through soil. During the rainy season, EFV has a meadow-like physiognomic appearance whereas the dry season aspect is almost desolate with the bare exposed soil covered with sparse desiccated plant remnants. It is the



most interesting community on outcrops and includes high percentage of insectivorous *Utricularia* together with *Eriocaulon* spp.

Seasonality of the vegetation is very marked on the outcrops. The rocky plateaus present an entirely dry almost barren appearance during the summer and winter. However, with the first monsoon showers, the plateaus become water logged leading to a sudden greening of the rocks. Although the actual species composition varies with the type of outcrop and its location, the vegetation follows a similar pattern *viz.* vegetative growth of flora and flowering of geophytes in early monsoon, followed by gregarious flowering of ephemerals in late monsoon followed by flowering of grasses signifying the end of vegetation cycle on the outcrops in this region. Very few perennials are seen persisting through summer and winter. A general description of vegetation is provided here.

In the early monsoon, during June and July Poaceae members such as *Glyphochloa forficulata*, *Isachne lisboae* are abundant and dominant together with *Fimbristylis tenera* (Cyperaceae) and *Eriocaulon* spp. although all are in vegetative conditions. This phase is marked by the flowering of *Hypoxis aurea*, *Iphigenia stellata*. In August few species such as *Dipcadi montanum*, *Habenaria heyneana*, *H. panchganiensis*, *Swertia minor* reach flowering peak.

In the late monsoon phase in September, several species of early phases reach flowering peak. Most dominant are *Fimbristylis tenera* together with Poaceae members. *Hedyotis stocksii*, *Rotala* sp., *Flemingia neilgheriensis*, *Jansenella griffithiana* *Coelachne minuta*, *Indopoa paupercula* are most abundant at this time. This phase also shows mass blooming of *Utricularia* and *Eriocaulon* spp. Plant diversity and richness is highest in this phase (Highest recorded $H'=4.417$, $N=47$ in the Western Ghats outcrops). In one monsoon, up to 23 species were recorded in a single 1X1m quadrat indicating very high species richness.

In the post monsoon phase, abundance and dominance of Poaceae reaches peak with some grasses such as *Glyphochloa forficulata* almost singly dominant in most quadrats. Sub dominants include endemic *Dimeria* spp. *Ischaemum* spp. and *Dichanthium* spp. mostly in the fruiting stages. During winter the lateritic outcrops are parched dry with the exception of a few individuals of *Blumea malcolmii*, *B. oxydonta*, *Crotalaria vestita*, etc. In locally moist areas such as drying rock pools, *Pogostemon deccanensis* and *Rotala densiflora* remain. *Indigofera dalzellii* that occurs commonly on the lateritic plateaus starts flowering in May with pre-monsoon showers and continues to flower throughout the monsoon, reaching fruiting stage in October.

Abundance and dominance of endemics is an important feature of this habitat. Based upon primary and secondary data, about 150 endemic species have been recorded to occur on rocky plateaus in the Northern Western Ghats and Konkan areas. Many of these endemics (*viz.* *Aponogeton satarensis*, *Ceropegia jainii*) show highly restricted geographical distribution and are specific to microhabitats. Forty of these are listed as threatened according to IUCN criteria by the Botanical Survey of India. Monotypic *Indopoa paupercula* and *Bhidea burnsiana* are restricted to the rocky areas in general and are abundant on the rock outcrops. *Dimeria woodrowii* is exclusively seen on the low level lateritic plateaus. Others like *Ceropegia*, *Hedyotis* have obligate endemic species on ferricretes in addition to several related species in the surrounding shrub savannahs, forests and wetlands. Highly specialized ephemeral flush vegetation and abundance of endemic species seen no where else in world, makes outcrop vegetation in Maharashtra globally unique.

Details of some important threatened plants seen on outcrops are provided here:

***Cyathocline lutea*: endangered**

This is a small annual of Asteraceae which grows on basaltic outcrops in shallow depressions. Secondarily it is also seen growing along field edges and in areas of moist soil. It has a small rosette of leaves through which emerges a long



stalk about 10-15 cm high bearing bunch golden yellow coloured capitula. Though small in size the herbs spread over large areas and bloom en masse in September, imparting golden yellow colour to entire landscape. The species is found only on basaltic outcrops atop the Western Ghats, in Nasik and Pune districts. Though locally abundant, it is threatened by changes in land use such as conversion of outcrops in agricultural areas, overgrazing and fires which change the species composition. It is necessary to prevent these activities to conserve this beautiful species.

***Habenaria panchganiensis* : Critically endangered**

This beautiful ground orchid grows mostly on lateritic plateaus at 1000-1200mASL. A cluster of radical leaves emerge from the bulb during heavy rainfall of July. The flowers are bright white and bloom for about two weeks between July and August. Locally the populations are small about 2-3 individuals per 5X5 square meters. The populations are seriously threatened by conversion of the outcrops into entertainment areas for monsoon tourism. In addition mining for bauxite is seriously threatening the habitat. It is necessary to provide special protection from trampling tourists and also develop *ex situ* conservation techniques for this species.

***Aponogeton satarensis* : Endangered**

This tiny geophyte grows in shallow seasonal rock pools on lateritic plateaus at 1000-1200mASL. A short stalk and few leaves emerge above water. The inflorescence stalk is bifurcated, with characteristic Y-shape appearance, bearing tiny pink flowers during July, August. It is known from only a few localities so far and has small populations. These sites are threatened by landscape conversion by mining, tourism development and windmill farms leading to slow degradation of the microhabitats. It can be conserved by protecting the sites and also by *ex situ* conservation in shallow aquatic gardens.

***Euphorbia panchganiensis* : endangered**

This geophyte has a large underground rhizome which remains dormant for almost 7 months. The inflorescence of bright red colour emerges above ground during summer (March-April). The radicle leaves appear as rosettes during monsoon after the fruiting and dispersal of seed is over. Locally the populations of this species are moderate sized, but the sites are heavily grazed, and trampled. Summer fires set by people are highly disturbing to the outcrop vegetation, and though this species survives through it, the dispersal becomes limited. It is necessary to develop *ex situ* as well as *in situ* measures for its conservation.

***Dipcadi concanense* : Critically endangered**

This is one of the most beautiful ground lilies which grow during the monsoon on lateritic plateaus of Konkan. The species was first recorded about a century ago from Malvan, but has now vanished almost completely through its range. It still survives on the extensive plateau of Ratnagiri town, sometimes growing in the backyards of houses. A few more localities are also known from the same area and Goa. The underground bulb gives out few narrow linear leaves and the flowering scape is tall, about 30cm tall and bears one or two long tubular flowers abt 4cm long and of purest white. The site in Ratnagiri area is being converted for housing and is proposed MIDC area, threatening the large population there. *Ex situ* conservation is thus absolutely necessary for this ornamental species.

The rock outcrops also support insects, fish, amphibians, reptiles and birds which have adapted to live in the stressful environment. Small mammals like rodents feed on underground parts of the vegetation. Bats inhabit underground lateritic caves. During the survey, activity of large mammals such as gaur, leopards was often seen on outcrops in Protected Areas. Recently new species of caecilians have been identified on lateritic outcrops.



Plate 21A
Rock Outcrops as Special Habitats in Western Ghats



Ephemeral flush vegetation on lateritic outcrops in Konkan with dense growth of *Utricularia reticulata* and *Eriocaulon* spp. ©Ashok Captain



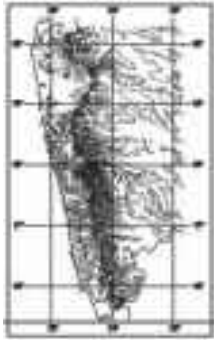
Crevices: on outcrops are very common microhabitats for moss and Poaceae ©Ashok Captain



Seasonal rock pool: on lateritic outcrop with dense growth of rare *Eriocaulon tuberiferum* ©Aparna Watve



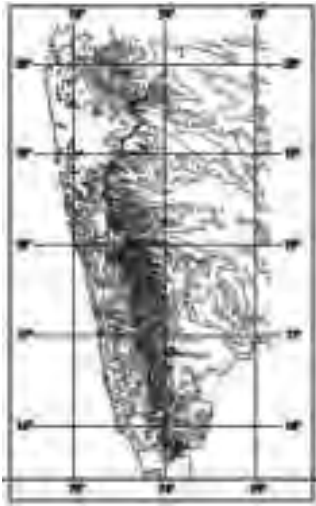
Plate 21B Threatened Species of Rocky Habitats – W. Ghats



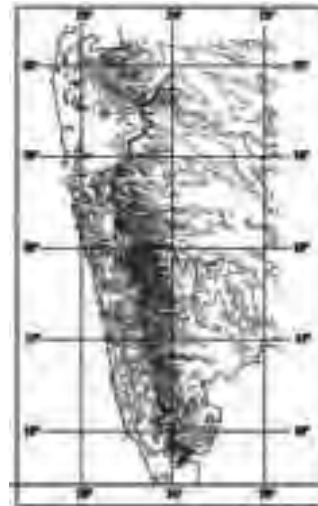
Cyathocline lutea growing in soil filled depressions on basalt outcrop
[©Aparna Watve]



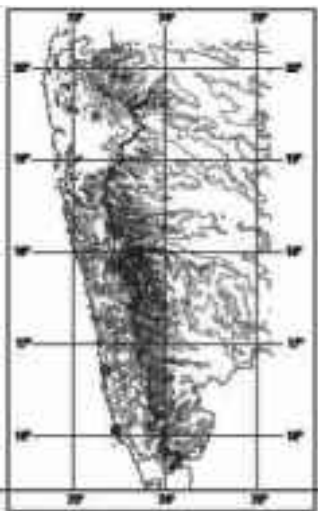
Euphorbia panchganiensis
[©Aparna Watve]



Habenaria panchganiensis
[©Sanjay Thakur]



Aponogeton satarensis [© Sanjay Thakur]



Dipcadi concanense [©Ashok Captain]



Rock outcrops are important as grazing lands for surrounding villages. The shrines of deities worshipped by shepherds and places of ancestral worship on these outcrops have a special socio-cultural value for local communities. The rocky plateaus also serve as watershed areas, and support large ponds or have perennial water sources along the edges which are extremely important for local people as well as livestock.

There is however, a serious lack of awareness in society regarding the biological, social and cultural importance of rock outcrop habitats. The dry physical appearance has misled government departments to classify these as wastelands. This has led to disastrous results as many activities have been allowed on the outcrops without adequate Ecological Impact Assessments. Mining for bauxite has led to destruction of prime habitats in Kolhapur. Ferricretes in Konkan are converted into mango orchards. Extensive rocky plateaus in Satara district have been converted to windmill farms, causing a slow degradation of vegetation by invasion of weeds, changes in drainage pattern and fragmentation by roads and fencing. Rocky plateaus at Panchgani and Kas, known for exceptional natural beauty are under threat from growing tourism, insensitive to the fragility of their environment. Only those outcrops which are present within wildlife sanctuary areas of Chandoli, Koyana, Radhanagari and Dajipur receive some protection. However, they have not received any special locale specific importance. It is thus necessary to take immediate steps towards the preservation of these unique habitats both within and outside PAs.

Suggested measures:

- Limiting destructive activities such as mining, plantation, tourism, constructions and burning on plateaus
- Enhanced protection of rock outcrops within existing protected areas and protection of additional representative sites to complement currently protected outcrops

Complete assessment of the floral and faunal richness of the habitat including those in the Reserved Forests and revenue lands

- Awareness generation about the importance of preserving these habitats

In addition to this, it is extremely necessary for researchers, environmental managers and others to understand the special nature and uniqueness of rock outcrop habitats and their global conservation significance.

References

Porembski, S., U. Becker & R. Seine. 1998. Islands on islands: habitats on Inselbergs. *Ecological Studies* **146**: 49-67.