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Biodiversity: Western Ghats rivers and wetlands

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Seasonal Wetland Flora of the Laterite Plateaus of Coastal Uttara Kannada

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Low altitude (<100 m) flat topped laterite hills and plateaus abutting part of Central Western Ghats, in the coastal district of Uttara Kannada in Karnataka, are often considered a harsh, infertile and barren terrain covered with mostly scrub or isolated stunted clumps of bushes and hardy, dwarfish trees. All the while ignored was the rich seasonal life of rare herbal flora during the June to September period, when these plateaus on account of torrential rains turn into a network of seasonal pools and streams and slimy, algal covered shallow wetlands. These seasonal wetlands seldom ever studied, where surveyed from floristic and ecological angles during the rainy weather of 2012. The fertility of the substratum is reflected in the predominance among the herbs of the insectivorous *Utricularia* spp. And to lesser extent *Drosera indica* and *D. burmanii*. Partial parasitic scrophulariace herbs like *Ramphicarpa longiflora*, *Striga lutea*, *S. gesneroides*, *Sopubia delphinifolia* etc. also indicate the prevailing nutrient stress situation. The laterite expanses are notable for several endemic herbs such as *Eriocaulon fysonii*, *E. lanceolatum*, *E. cuspidatum*, *Rotala malampuzhensis*, rare grasses like *Danthonidium gammiei* and threatened endemic hydrophyte *Wisneria triandra*, and many more interesting species. Whereas pockets of soils amidst rocks have perennating tuberous herbs like *Ceropegia* spp., *Euphorbia acaulis*, *Curculigo orchioides*, *Theriophonum dalzellii*, *Ophioglossum* spp. Etc. hardy perennial herbs like *Lepidagathis rostrate* persist alive on eroded and porous boulders. As these laterite formations adjoining villages and towns have been subjected to encroachments, quarrying, removal of brushwood and trees, overgrazing by cattle and conversions into monoculture of *Acacia auriculiformis*, we put forth proposal for conservation of some of

the stretches of these unique formations, on the basis of their special biotic communities, into conservation reserves.

Keywords: Coastal Ecosystems, wetland flora, laterite plateau

INTRODUCTION

'Laterite' is the Latin word for brick. Francis Buchanan (1807) described laterite for the first time in Angadipuram in Kerala. Generally laterites are noted for their presence of large amounts of hydrated iron, aluminum and manganese oxides and harden on exposure to air; in wet conditions they are softer, and can be cut easily, cured and used as bricks. Bourgeon (1989) considers laterites/lateritic soils as characteristic of the coastal hinterland of Western Karnataka. This hinterland is formed by the dissection of old laterized geomorphic levels. In this geological relief closer to the coast are laterite capped mesas (tablelands with steep sides). These hardened flat topped, laterite highlands, seldom ever increasing 100 m in heights are striking features of the coast of southern Uttara Kannada. These tablelands on closer look are rugged in nature with micro-heterogeneity of protrusions, flatness and depressions, and in places interrupted with quarries from which bricks for construction are cut out. The convex portions are totally eroded, dark and honey combed in appearance, and nearly bare of any kind of vegetation, except certain hardy shrubs and dwarfish trees like *Sapium insigne*, *Flacourtia indica*, *Ficus arnottiana* etc., the latter a remarkable plant which has roots clinging on firmly to the rock boulders which are practically destitute of soil. The depressed areas and shallow pits having thin layer of soil turn into a veritable treasure trove of herbaceous flora during the peak of rainy season, especially from end June to mid-September when the laterite plateaus as a whole turn into a carpet of greenery, of marshes and boggy places and flatter portions all covered with a rich and rarely explored flora of bewildering diversity, a picture of which is presented here. This study

highlights the present status of some laterite plateaus in coastal Uttara Kannada in relation to their floral diversity, endemism and, their threatening anthropogenic pressures in coastal Uttara Kannada.

MATERIALS AND METHODS

The work was carried out in the Uttara Kannada district (74° 9' to 75° 10' E and 13° 55' to 15° 31' N) towards the northern coast of Karnataka State, South India (Figure 1). In Uttara Kannada, the Western Ghats are at their lowest elevations, not exceeding 600 m in most places with an occasional peak rising to 700 or 800 m from msl. The mountainous terrain come closest to the Arabian Sea in this district, where towards the north-west, in the Karwar-Ankola taluks, the promontories of the ghats even enter into the Arabian Sea. From Ankola taluk in the north through Kumta, Honavar to Bhatkal taluk in the south, these spectacular coastal formations of flattened table lands and gently rising low hills of laterite, were sampled in 12 localities (Table1). All the study sites were below 100 m altitude, some bordering the sea shore the other within few km eastwards into the hinterlands. Although there is sparse growth of woody, perennial plants, both shrubs and dwarf trees, which are of commoner kind, our studies were mainly focused on the herbal flora of the rainy season.

RESULTS AND DISCUSSION

Plant Diversity

A total of 140 species of flowering plants under 44 families, most of them herbaceous, and some woody species were inventorised. Family Poaceae had the highest number of species (19) dominated by *Dimeria*, *Arundinella*, *Eragrostis* etc. (Figure

2); these grow well where soil cover is reasonably good. Predominantly grassy places had good mix of leguminous herbs (15 sp) notably of the genera *Geissaspis*, *Smithia*, *Zornia*, *Crotalaria* etc. Marshy areas and wet soils were dominated by Scrophulariaceae herbs (12 species) which occurred in association with many members of similar habitats from Cyperaceae, Eriocaulaceae etc. Of the eight species of *Eriocaulons* four species were endemics to the Western Ghats-west coast. *Neanotis foetida* of Rubiaceae and *Murdannia semeteris* of Commelinaceae were sometimes the only herbs on few mm of wet soils on laterite. Euphorbiaceae had 6 species of which *Euphorbia fusiformis*, a herb with large thick

leaves and fairly large tuberous perennating root, was very rare. Nowhere else could occur congregations of insectivorous herbs except on wet laterites, with at least six species of bladderworts (*Utricularias*) and two of sundews (*Drosera indica*, *Drosera burmanii*). Whereas these of Lentibulariaceae and Droseraceae compensate for the rain washed nitrogen deficient soils through supplementary nutrition of insectivory, the predominance of leguminous herbs is due to their association with N-fixing bacteria in their roots. Semi-parasitism is a striking feature to compensate for nutritional deficiency especially in the *Strigas*, *Sopubias* and *Ramphicarpa* of Scrophulariaceae.

Figure 1: Localities of laterite flora studies (depicted on Google imagery in reddish hue)

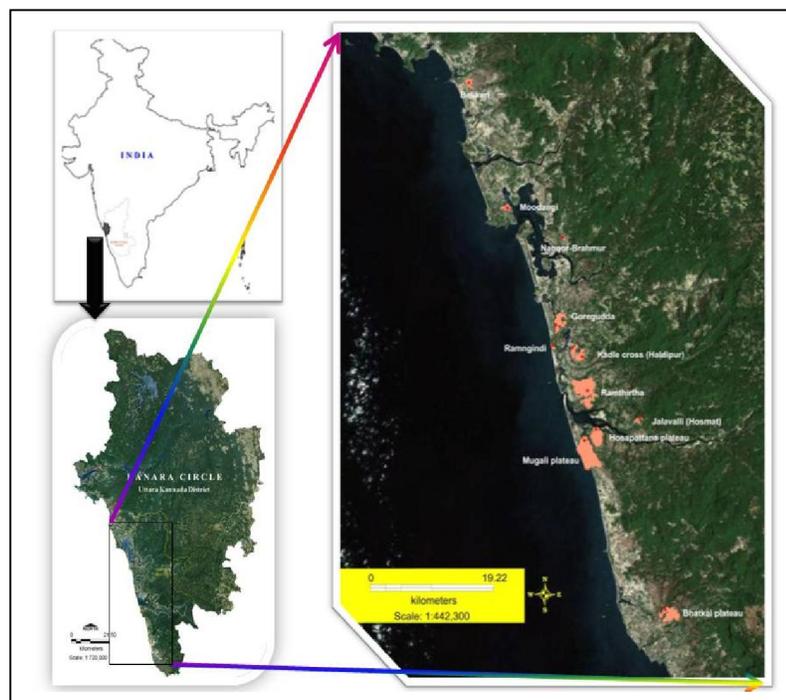


Table 1: Study localities in coastal Uttara Kannada

Sn.	Study localities	Taluk	Lat	Long	Elevation (m)
1.	Belekere	Ankola	14.70335	74.28675	53
2.	Bhatkal plateau	Bhatkal	14.01586	74.56985	95
3.	Chippihaklu (Navilgon)	Honavar	14.35763	74.43599	74
4.	Hosapattana plateau	Honavar	14.25101	74.47056	62
5.	Jalavalli (Hosmat)	Honavar	14.2657	74.53316	85
6.	Kadle cross (Haldipur)	Honavar	14.3458	74.4503	76
7.	Mugali plateau	Honavar	14.23678	74.45347	55
8.	Ramthirtha	Honavar	14.3017	74.45791	66
9.	Goregudda	Kumta	14.38729	74.41229	70
10.	Moodangi	Kumta	14.53949	74.34276	63
11.	Nagoor-Brahmur	Kumta	14.50173	74.42188	27
12.	Ramangindi	Kumta	14.36093	74.4084	71

Figure 2: Family-species richness in laterite plateaus (families with minimum 2 species represented)

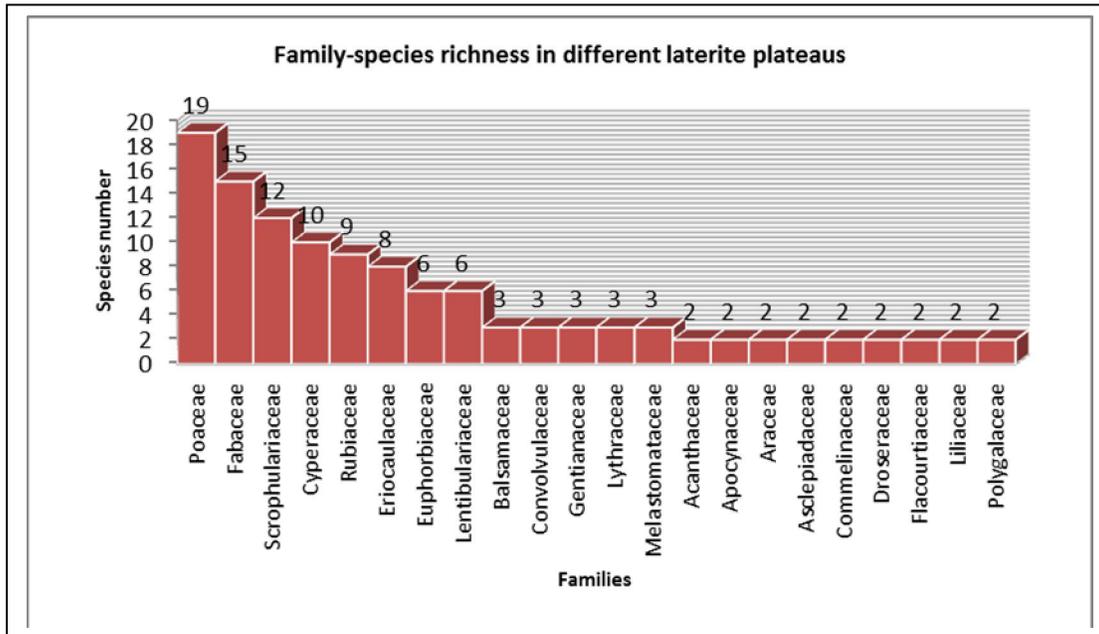


Figure 3: Total species number catalogued from 12 laterite plateaus of Uttara Kannada

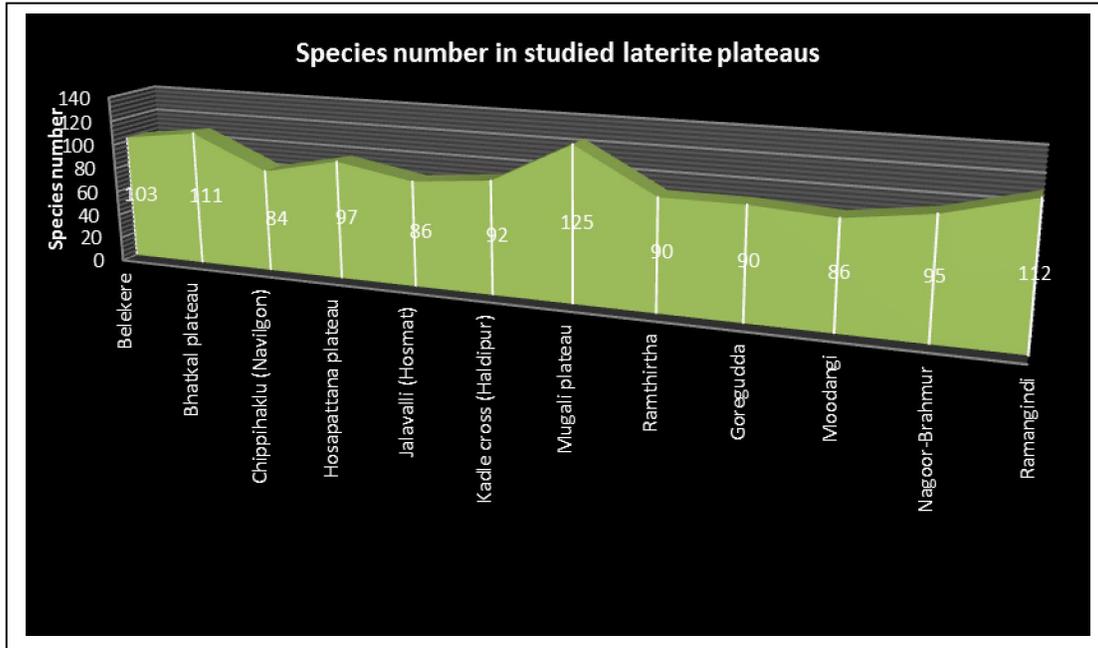


Figure 4: Western Ghats, India-Sri Lanka and combined endemism percentage in different laterite plateaus

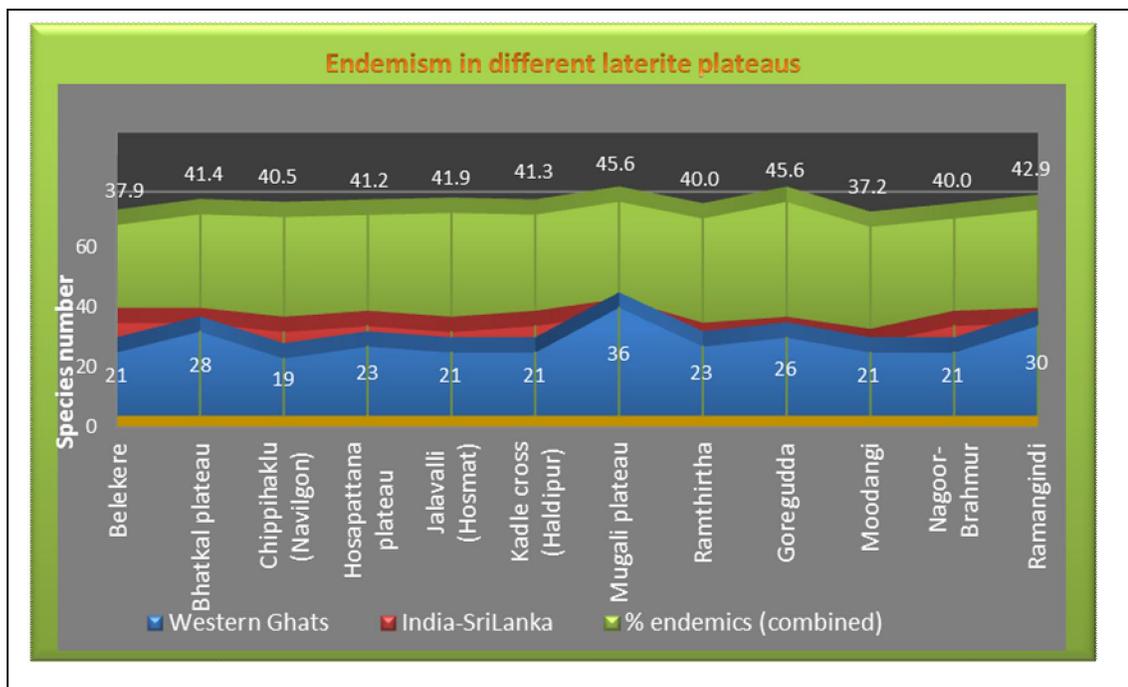


Table 2: Some newly discovered and threatened species from the laterites of Western India

Sn.	Species	Distribution in India	Reference
1.	<i>Eriocaulon madayiparense</i>	Kerala	Swapna et.al. (2012)
2.	<i>Chamaesyce katrajensis</i>	Kerala	
3.	<i>Dipcadi goaense</i>	Maharashtra	Prabhugaonkar et.al. (2009)
4.	<i>Eriocaulon belgaumensis</i>	Karnataka	Shimpale, et.al. (2010)
5.	<i>Eriocaulon epedunculatum</i>	Maharashtra	Yadav, et. al.(2008)
6.	<i>Eriocaulon kannureense</i>	Kerala	Sunil et. al. (2012)
7.	<i>Eriocaulon sivarajanii</i>	Kerala	Ansari R and Balakrishnan N.P (2009)
8.	<i>Justicia ekakusuma</i>	Kerala	Pradeep et.al. (1991)
9.	<i>Lepidagathis keralensis</i>	Kerala	Madhusoodanan P.V and Singh N.P. (1992)
10.	<i>Lindernia madayiparense</i>	Kerala	Narayanan et. al. (2012)
11.	<i>Nymphoides krishnakasara</i>	Kerala	Joseph K.T and Sivarajan V.V (1990)
12.	<i>Paracautleya bhatii</i>	Karnataka	Smith R.M (1977)
13.	<i>Rotala malabarica</i>	Kerala	Pradeep et. al. (1990)

Species richness

Most lateritic plateaus were rich in especially seasonal herbs; higher richness occurred in Mugali of Honavar taluk (125 sp.), followed by Ramangindi of Kumta (112 sp.) and Bhatkal plateau (111 sp.) (Figure 3). Mugali and Bhatkal are associated with rare kind of wildlife, especially for pangolin, and mouse deer. *Utricularia's* and *Eriocaulons* and scores of other herbs in their mass flowering render great scenic beauty to the laterite plateaus during the peak of rainy season.

Richness in endemic and rare species

Endemism among seasonal herbs was exceptionally high, contrary to otherwise bleak and infertile nature of the terrain. Details regarding endemic number of Western Ghats (including west coast), and of India-Sri Lanka together as well as total endemism percentage are depicted in the (Figure 4). Mugali plateau

peaks in respect of Western Ghat endemics (36 sp.) followed by 30 of Ramangindi and 28 of Bhatkal. This is the first study of its kind for coastal Karnataka laterites bringing out their exceptional seasonal biodiversity and endemism. Recent years witnessed a spate of reports on new species of herbs from the laterite plateaus of Western India, including a new genus *Paracautleya bhatii* (Table 2). While the conservation status of many of these is yet to be evaluated *Rotala malabarica* and *Justicia ekakusuma* have figured in the IUCN Red List (2012) as Critically Endangered.

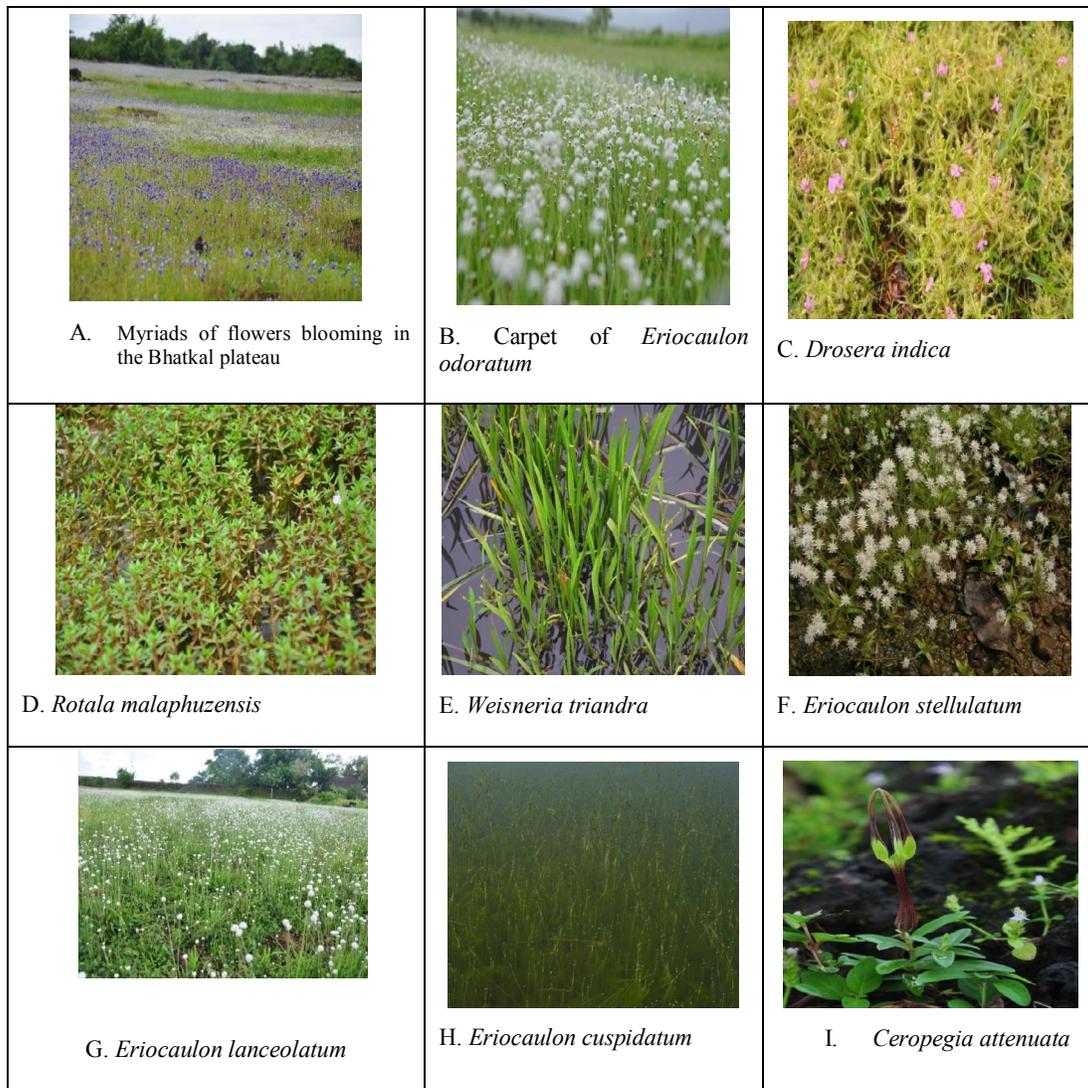
Species assemblages

The laterite hills have some characteristic woody perennial elements of stunted trees and shrubs as well such as *Sapium insigne*, *Strychnos nux-vomica*, *Zizyphus mauritiana*, *Grewia microcos*, *Flacourtia montana*, *Ficus arnottiana*, *Memecylon edule*, *Aglaiia eleagnoidea* etc. The

wetter valleys in between have more evergreen species which also might occur in the interior ghat forests. The wet season brings to the fore several microhabitats with their assemblage of characteristic species. Whereas seasonal, shallow bogs like habitats are characterized by *Eriocaulon cuspidatum*, *Weisneria triandra*, marshy areas have *Utricularias*'s and more members of *Eriocaulon* (Figure 5). As water, the most critical factor for prolific herbal richness dry up soon after the end of rains, the

seasonal herbs wither away furnishing a browner hue to the terrain, leaving behind only hardy herbs that cling on to life like xerophytes like *Lepidagathis prostrata* of Acanthaceae. Many plants of which the aerial green shoots appear in the rains have perennating tubers or bulbs in shallow soils; for e.g. *Euphorbia fusiformis*, *Curculigo orchioides*, *Iphigenia indica*, *Tacca pinnatifida*, *Theriophonum dalzellii* etc.

Figure 5: Glimpses of plant diversity of laterite plateaus in coastal Uttara Kannada



Conclusions

Formations of lateritic terrain along the South Indian west coast probably began about 90 million years ago with the separation of India from Madagascar, the steep escarpment side of the Western Ghats subjected to erosion and eroded materials getting deposited on the coast. In the course of time characteristic floral elements including the evergreen forest elements from the Western Ghats, colonized this terrain, as their relics to this day reveal. The beginnings of agriculture along the west coast, three millennia ago, was marked by the clearances of coastal hills and plateaus for shifting cultivation and savannization, intensifying the formation of laterite, with the exposure of tropical iron-rich, clayey soils alternatively to wet and dry climates. Laterites, for the first time described by Francis Buchanan (1807) from Angadipuram in north Kerala in 1801, are monumental geological formations requiring greater attention from conservationists, especially for their unique plant community. Unfortunately, being considered as an infertile and barren terrain, great portions of these are getting planted with monocultures of exotic *Acacia auriculiformis* and cashew (*Anacardium occidentale*), as well as used for quarrying building stones and utilized also rampantly for human settlements. Serious attempts along all of the Indian west coast to map species rich areas of unique laterite communities for conservation. We have already submitted to the Government of Karnataka proposal for consideration of Mugli and Bhatkal lateritic plateaus as Conservation Reserves (Chandran et. al. 2012).

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