

Discovery of Two Critically Endangered Tree Species and Issues Related to Relic Forests of the Western Ghats

M.D. Subash Chandran, D.K. Mesta, G.R. Rao, Sameer Ali, K.V. Gururaja and T.V. Ramachandra*

Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012, India

Abstract: *Madhuca bourdillonii* (Gamble) Lam. and *Syzygium travancoricum* Gamble, considered almost extinct but later found to be occurring in small numbers in their home range in Western Ghats, south of Palghat Gap, have been now discovered in some of the relic primeval evergreen forests of Uttara Kannada, over 700 km north. These relic forests also shelter scores of other rare endemic elements of flora and fauna. These findings highlight the need for making intensive efforts for locating more of such relic forests and documenting their biota. Also, biologists need to restrain from the tendencies of considering any novel occurrences of species away from their home ranges as new species, before ruling out the possibilities that these could be the relics of ancient populations or their morphological variants. Presence of relic forests does reveal the legacy of erstwhile contiguous forests, which is now fragmented due to rapid land use changes. Conservationists handling biodiversity hotspots should be able to distinguish between relics of primeval forests and advanced stages of secondary successions. Lack of such understanding will result in imperceptible extinctions of many endemic species.

Keywords: *Madhuca bourdillonii*, *Syzygium travancoricum*, critically endangered, relic forests, *Myristica* swamps, local extinction, Uttara Kannada, Western Ghats.

INTRODUCTION

The Western Ghats is one among the 34 global hotspots of biodiversity and it lies in the western part of peninsular India in a series of hills stretching over a distance of 1,600 km from north to south and covering an area of about 1,60,000 sq.km. In the course of our ecological studies in the Uttara Kannada (formerly North Kanara) district of central Western Ghats, we came across two critically endangered tree species, far away from their home range much in the south. These trees viz., *Madhuca bourdillonii* (Gamble) Lam. and *Syzygium travancoricum* Gamble, were even considered almost extinct. Their rare presence in some of the relic evergreen forests of Uttara Kannada, over 700 km towards the north of their original home range, in southern Western Ghats, that too beyond the geographical barrier of the Palghat Gap, which halts the continuity of several sensitive endemics, throws up before us fresh questions regarding conventional approach to conservation, which has not given due merit to the ecological history of the region. These tree species occur in the vicinity of some of the *Myristica* swamps of the district, which are obviously part of the relic patches of primeval low altitude evergreen forests that survived human impacts to some degree. Historically, the overall forest disturbance in the Western Ghats increased in spatial extent as well as in intensity, during the post World war era, with the emphasis on industrialization and economic development. Forest based industries coupled with large scale hydroelectric projects and conversions of forest land for agriculture have contributed significantly in the decline of primeval forests. The *Myristica* swamps did not get enough attention until Chandran and Mesta [1] reported them

as highly threatened relics of primeval forests of the Western Ghats. These swamps have high watershed value and are associated with perennial water courses. They also act as a treasure trove of endemic plants and animals of ancient lineage. These swamps are dominated by species of *Myristicaceae* (nutmeg family), one of the most ancient families of flowering plants. *Myristica fatua* var. *magnifica* (Bedd) Sinclair and *Gymnacranthera canarica* (King) Warburg, are tree species exclusive to the swamps. Recent discovery of *Semecarpus kathalekanensis*, an altogether new tree species of the mango family *Anacardiaceae* [2], in these swamps has created ripples in the conservation circles.

The micro-heterogeneity of these relic evergreen forests has several more endemic and interesting plant species, which include the trees *Dipterocarpus indicus*, *Mastixia arborea*, *Agrostystachys longifolia* and *Myristica malabarica* (Fig. 1); an undergrowth palm *Pinanga dicksonii*, a species of pepper *Piper hookerii*, a tree fern *Cyathea nilgirica*, etc. Lion-tailed macaque, an endemic endangered primate of the Western Ghats, has its northern-most range in the relic evergreen forests of southern Uttara Kannada, which also often harbour *Myristica* swamps. In addition are several other rare endemic animal species, which include amphibian genera like *Nyctibatrachus* and *Micrixalus*. The *Myristica* swamps of southern Uttara Kannada are found to harbour 29 species of amphibians of which 19 are Western Ghat endemics. Birds like Wyanad laughing thrush and Malabar pied hornbill associated with these swamp forests are also endemics. *Phylloneura westersmanii*, a damselfly of endemic monospecific genus *Phylloneura* was recently found in *Myristica* swamps of Siddapur (14.5° N), the northern range of which was earlier considered to be Coorg (12° N) district [3].

The *Myristica* swamps, which are sure indicators of relics of primeval forests of the Western Ghats, today occur in iso-

*Address correspondence to this author at the Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012, India, E-mail: cestvr@ces.iisc.ernet.in

lated patches; the southern-most swamps are found in Travancore region and the northern-most occur in Goa. Due to ever increasing human impacts, over the last few centuries, most of the primeval forests have given way to secondary forests, savannas, monoculture tree plantations, cash crops such as tea, coffee and rubber, rice fields, arecanut gardens, etc [4,5]. In addition, developmental projects such as hydel, and nuclear power plants, mining, etc., have mushroomed especially during the post-independence period. Nevertheless, the remains of numerous ancient sacred groves, specially preserved pepper forests of the past and many forest patches with difficult approach are serving as repositories of the endemic biodiversity of Western Ghats. Recent study of Western Ghats using WiFs (wide field sensor with spatial resolution of 70 m) remote sensing data mapped certain unique evergreen forest patches, which coincided with *Myristica* swamps, *Ochlandra* reed ecosystems and *Nagea wallichiana* facies [6], which are obviously relics of primary evergreen forests.

Myristica swamps are considered as priceless possessions for evolutionary biology. The swamp, with its entanglement of aerial roots, and canopy of dark green large leaves, and high degree of endemism, is doubtlessly, the relic of one of the most primeval ecosystems of the Western Ghats. As much remained undone regarding the diversity and ecology of these swamps, they are considered “virtually live museum of ancient life of great interest to biologists”[1,4]. With the presumption that the *Myristica* swamps and their immediate surroundings, studded with *Dipterocarpus* trees (Fig. 1), could shed some light on the nature of the primeval low altitude evergreen forests of Uttara Kannada district, we began surveying these forest relics more systematically. Our search resulted in the discovery of two critically endangered tree species viz., *Madhuca bourdillonii* (Gamble) Lam. and *Syzygium travancoricum* (Gamble). We consider the occurrence of these species in Uttara Kannada as very significant due to the following reasons:

- These species were originally reported only from Travancore region [7].
- They were feared to be extinct according to the *Red Data Book of Indian Plants* [8,9].
- Subsequent investigations revealed their rare presence in southern Western Ghats, but only towards the south of the Palghat Gap [10,11].
- The *Myristica* swamps near which we found these species had the status of *kan* forests. The *kans* were safety forests cum sacred groves during the pre-colonial times [12].

***Madhuca bourdillonii* (Gamble) Lam.**

Bourdillon [7], the discoverer of this species in Travancore during 1894-95 described it as a “rare tree of medium size occurring in the Ariankavu and Shenduruny valleys, but not seen elsewhere”. Gamble [13], quoting Bourdillon, also described it in the *Flora of the Presidency of Madras* (vol.2). The *Red Data Book of Indian Plants* considered its status as “possibly extinct”, since the species was not collected after Bourdillon’s observation. The book states [9], “Indiscriminate and steady destruction of its natural habitats, compounded by selective felling of *Madhuca* trees in the past for

their purported all round value, accounts for the present day state of scarcity in the Western Ghats region”. Sasidharan and Sivarajan [10] found this species in the forests of Thrissur district (10.66° N, 76.25° E), to the north of the type localities. Later, it was also found in its type localities namely Arainkavu and Shenduruny valley and was reported [11] as “rare”.



Fig. (1). A relic forest with *Dipterocarpus indicus*.

OCCURRENCE OF *M. BOURDILLONII* IN UTTARA KANNADA

Notably all the findings of the species hitherto were towards the south of Palghat Gap, until we came across a rare population in Ankola taluk (14.7° N), of Uttara Kannada district, in the central Western Ghats. Our find extends the northern limit of the species by about 500 km; but more significantly, this is the first report of the species from north of the Palghat Gap. Fig. (2) depicts these locations along with the earlier sightings. There were only 13 trees of this critically endangered species dispersed within a stretch of evergreen forests. Three of them exceeded 30 m in height and were about 2 m in girth while others were much smaller. These trees occurred in a relic forest characterised by a *Myristica* swamp and endemic trees such as *Aglaia anamal-layana*, *Dipterocarpus indicus*, *Garcinia talbotii*, *Holigarna* spp., *Gymnacranthera canarica*, *Knema attenuata*, *Myristica malabarica*, etc. Incidentally, this site is also a northward extension for *D. indicus* by about 30 km, from the previous report [14].

DESCRIPTION OF *M. BOURDILLONII*

Madhuca bourdillonii is a medium to large tree exceeding 30 m height at maturity (Fig. 3a). Though described as an evergreen [9], it has a brief period of leaf-fall, which is not strictly season bound. Flowering is simultaneous with leaf-fall and new flush that follows is mingled with late

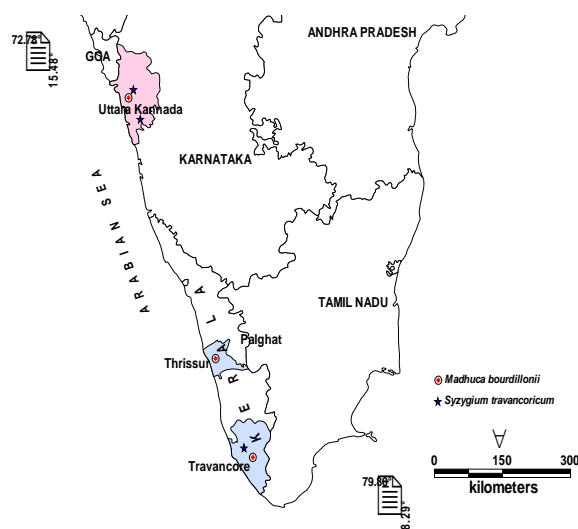


Fig. (2). Distribution map of *Madhuca bourdillonii* and *Syzygium travancoricum* in the South-west India.

blooming flowers and early fruits. The trees have grayish brown, longitudinally fissured and flaky bark with a pinkish interior (Fig. 3b). The plant parts have milky latex like other species of *Madhuca*. Young shoots, including young leaves, are densely covered with brownish-orange, wooly hairs. In the mature leaves the undersurface of veins retains the hairs. In other related species like *M. longifolia* var. *longifolia* and *M. longifolia* var. *latifolia* and *M. neriifolia* mature leaves are not hairy. The leaves are simple (Fig. 3a) reaching dimensions of 20-32 x 6-10 cm and crowded towards the tips of branchlets. They have conical base and bluntly acute to narrowing tips. In having 20-25 pairs of lateral nerves *M. bourdillonii* stands apart from its close associates *M. longifolia* var. *longifolia* (10-12 pairs) and *M. longifolia* var. *latifolia* (10-14 pairs). Flowers appear in dense clusters (Fig. 3c) from the axils of fallen leaves or of older leaves that are about to fall. When the tree is in full bloom, clusters of young leaves appear from the tips of branchlets. The stalks of flowers, 1.5-2 cm long, are also covered with dense hairs. Sepals are 4, ovate and hairy outside. Corolla consists of 12 united petals. Stamens are often twice the number of petals, in two whorls. The anther is tipped with a narrow outgrowth.

Genus *Madhuca* produces berries (Fig. 3d) with one to few seeds. Globose fruit is a key distinguishing character of *M. bourdillonii*. *Madhuca longifolia* var. *latifolia* has globose fruit, with oblique apex [15] and *M. longifolia* var. *longifolia* has ovoid fruit. Both these varieties have 1 or 2 seeds whereas *M. bourdillonii* has 2-3 seeds (Fig. 3e). Table 1 compares the various *Madhuca* spp. of South India.

Syzygium travancoricum Gamble

The tree was first discovered in the swampy lowlands (altitude <65 m) of Travancore by Bourdillon in 1894. Gamble [17] described it in 1918 in the *Kew Bulletin* and in the *Flora of the Presidency of Madras* in 1919. The *Red Data Book of Indian Plants* [8], quoting Nair and Mohanan [18], states: "Apparently no tree is surviving in the type locality. Recently only four trees have been spotted in a sacred grove of Aikad in Quilon district". However, Sasidharan [11] re-discovered it in the type locality - Shenduruni Wildlife Sanctuary. According to him this species, endemic to south-

ern Western Ghats of Kerala, is associated with the *Myristica* swamp forests.

OCCURRENCE OF *S. TRAVANCORICUM* UTTARA KANNADA

We came across about 35 trees of this species in association with some of the *Myristica* swamps of Siddapur taluk (14.4° N). The tree occurred along with several other Western Ghat endemics such as *Aglaia anamallayana*, *Calophyllum apetalum*, *Diospyros paniculata*, *D. pruriens*, *Dipterocarpus indicus*, *Gymnocranthera canarica*, *Holigarna grahamii*, *Hydnocarpus pentandra*, *Hopea ponga*, *Mastixia arborea*, *Myristica fatua* var. *magnifica*, *Pinanga dicksonii*, etc. In Ankola taluk, a single tree was observed in a *Myristica* swamp (Fig. 4a). Some bushy forms, obviously coppice shoots (Fig. 4b), occurred close to it. The occurrence of the species in Ankola is a range extension for it by about 700 km from Travancore (Fig. 2), where it was considered to be restricted.

DESCRIPTION OF *S. TRAVANCORICUM*

Gamble [17] described the species as medium sized or large tree, while, Sasidharan [11] found only small trees. The largest trees that we observed were about 30 m in height. Two of the trees had girths of 253 and 254 cm respectively. The older trees have buttresses at the base. The young branchlets are 4-angled; in the saplings the angles are winged. Stream side trees have floating water roots, an adaptation to swampy habitat (Fig. 4c). Leaves are simple, opposite, ovate and bluntly acute towards the tip. The leaf base is shortly decurrent (continued) on the 2 cm long petiole. Leaf measures 9-18 cm in length and 6-9 cm in breadth. It has 12-15 pairs of lateral nerves. Flowers occur in the axils of leaves in corymbose cymes of 5-8 cm long (Fig. 4d). They are very small, only 3 mm across. The white petals form a calyptra (cap) in the bud enclosing the stamens. Fruits 0.7-1 cm across, purplish to maroon-red (Fig. 4e). Fruits ripen in May-June. None of the floras provide the description of the fruit although it is sketched in the flora of Shenduruni Wildlife Sanctuary [11].

THE VALUE OF FOREST PATCHES

The impact of forest fragmentation is severe in the tropics, where biodiversity is rich, and human populations are rapidly growing. Studies show decline of forest birds [19], large wide ranging species [20] and more specifically specialised species [21] that require unique habitat for survival. It also influences distribution and availability of spatial resources, forest connectivity and edge characteristics, which are important for species persistence [22-24]. Also, trees in the fragmented habitats have higher annual tree mortality rates due to vagaries of wind [25]. Fragmentation effects cascade through the community, modifying inter-specific interactions, providing predator or competitive release, altering social relationships and movement of individuals, exacerbating edge effects, modifying nutrient flows, and potentially even affecting the composition of local population [26]. In many tropical regions, rain forest is restricted to small (<100 ha), isolated fragments. The conservation of such smaller fragments had not merited much attention till recent years. In regions like Western Ghats, there is not much hope for creation of more and more large-sized protected area systems due to social, economic and political



Fig. (3). a) *Madhuca bourdillonii* in flush; b) An old tree of *M. bourdillonii* – showing fissured and flaky bark; c) flower; d) fruit and e) seeds.

Table 1. Comparative Morphology of Different Species of *Madhuca*

Characters	<i>M. bourdillonii</i>	<i>M. longifolia</i> var. <i>longifolia</i>	<i>M. longifolia</i> var. <i>latifolia</i>	<i>M. neeriifolia</i>	<i>M. insignis</i>
Tree height	Large (>25 m)	Large (>25 m)	Large (>25 m)	Small (8-10 m)	Moderate
Bark	Grayish brown, fissured and flaky	Dark brown, scaly	Dark, fissured and scaly	Dark, scaly	
Leaf size (cm)	20-32 x 6-10	5.5-12 x 1.5-4	7-22 x 5-14	7-24 x 3-6	9-13 x 4-6
Leaf hairiness (mature leaf)	Petioles and underside of veins with brownish-orange, woolly hairs	Glabrous	Glabrous	Glabrous	Glabrous
No. of lateral nerves (pairs)	20-25	10-12	10-14	14-25	11-13
Ovary	Glabrous	Hairy	Hairy	Glabrous	
Fruit shape	Globose	Oblong	Globose with oblique apex	Fusiform, beaked	Fusiform-ovoid
Surface of mature fruit	Glabrous	Hairy	Hairy	Glabrous	Glabrous
No. of seeds	2-3	1-4	1-4	1	1

Table based on observations by authors and floras of Bourdillon [7], Gamble [13], Saldanha [15], Sasidharan and Sivarajan [10], Sasidharan [11], Bhat [16].

constraints [27, 28]. Also, the presence of roads, power lines and substantial nearby human population has prevented the recovery [29]. 'Forest patches' include a diversity of habitats which are in close proximity forming a mosaic, or even in isolation like a sacred forest in the middle of a village or small town. Investigations into the ecological history of the Western Ghats reveal that the forests here, especially of altitudes below 1000 m, constitute a mosaic of patches of varied nature and ages.

In the Uttara Kannada district of central Western Ghats, where we conducted our present study, this landscape mosaic, according to traditional pre and early colonial land use, typically consisted of sacred forests (*kans* or *devarabana*), ordinary forests (*kadu* or *adavi*), shifting cultivation areas (*kumri* or *hakkalu*), leaf manure forests (*betta*), grazing lands (*beta*), etc., in addition to lands under permanent agriculture and horticulture. Such traditional mosaic within it might contain streams, ponds, waterfalls and rivers, gorges and steep slopes and rocky pinnacles, each with its own characteristic species composition [12, 27-28, 30]. Sacred forest fragments are shelters of biodiversity, meeting the needs of non-timber forest produce requirement and are best protected by local communities [31]. The lower altitudes of pre-historical Western Ghats, before the beginning of shifting cultivation, around 3,000 years ago, would have been covered with pristine ecosystems, more or less untrammelled by man, except by hunter-gatherers, who seldom if at all, indulged in forest alterations. Especially due to the heavy rainfall, western facing portions of the mountains would have been covered with tropical evergreen forests, laced with water courses and swamps [24,27]. Earlier studies in the Western Ghats also showed that remnants foster successional processes in natural restoration of rainforests [32]. Shifting cultivation was a major activity of forest dwelling tribals, throughout the Western Ghats, sparing only the higher altitudes. Carried out

through centuries this might have altered substantially the primary evergreen forests. In sparsely populated interior places of South Indian Western Ghats, the forests would regrow and through time get back most of the original elements of the flora barring a few, as the fallow period was long (sometimes the tribes never returned to the original areas). As fire was an important factor in shifting cultivation, it may be that hygrophilous endemic tree species such as *Dipterocarpus indicus* and *Vateria indica*, failed to regenerate on slash and burn areas, but survived in protected areas like the sacred forests. The same could be true of *Madhuca bourdillonii* and *Syzygium travancoricum* (Fig. 5).

DISCUSSION

Forest history of Uttara Kannada reveals that shifting cultivation was a decisive force that altered the primary forests substantially, creating vast stretches of secondary forests. The early agricultural communities, however, left behind a great legacy of sacred forests (*kans*) in Uttara Kannada and other adjoining districts. Many of these *kans* to this day are relics of the primary forests of the Western Ghats and are centers of endemism for both plants and animals. *Myristica* swamps are associated with some of these sacred forests [1,12,27,28]. These relics lost their special identity as sacred forests and got merged with the state reserve forests during the British administration [27]. Subsequently, they were subjected to commercial timber harvests, tree monocultures, etc. In many places, the *kans* were cut down for expansion of cultivation or converted into leaf manure forests or subjected to other kinds of human impacts [28, 29].

Our finding of *Dipterocarpus* in Ankola (14.7° N) goes to substantiate Caratini *et al.* [33], who have reported the presence of its pollen in marine core samples close to Kali River estuary (14.8° N). This is incidentally range extension of present distribution of *Dipterocarpus* towards north by 30

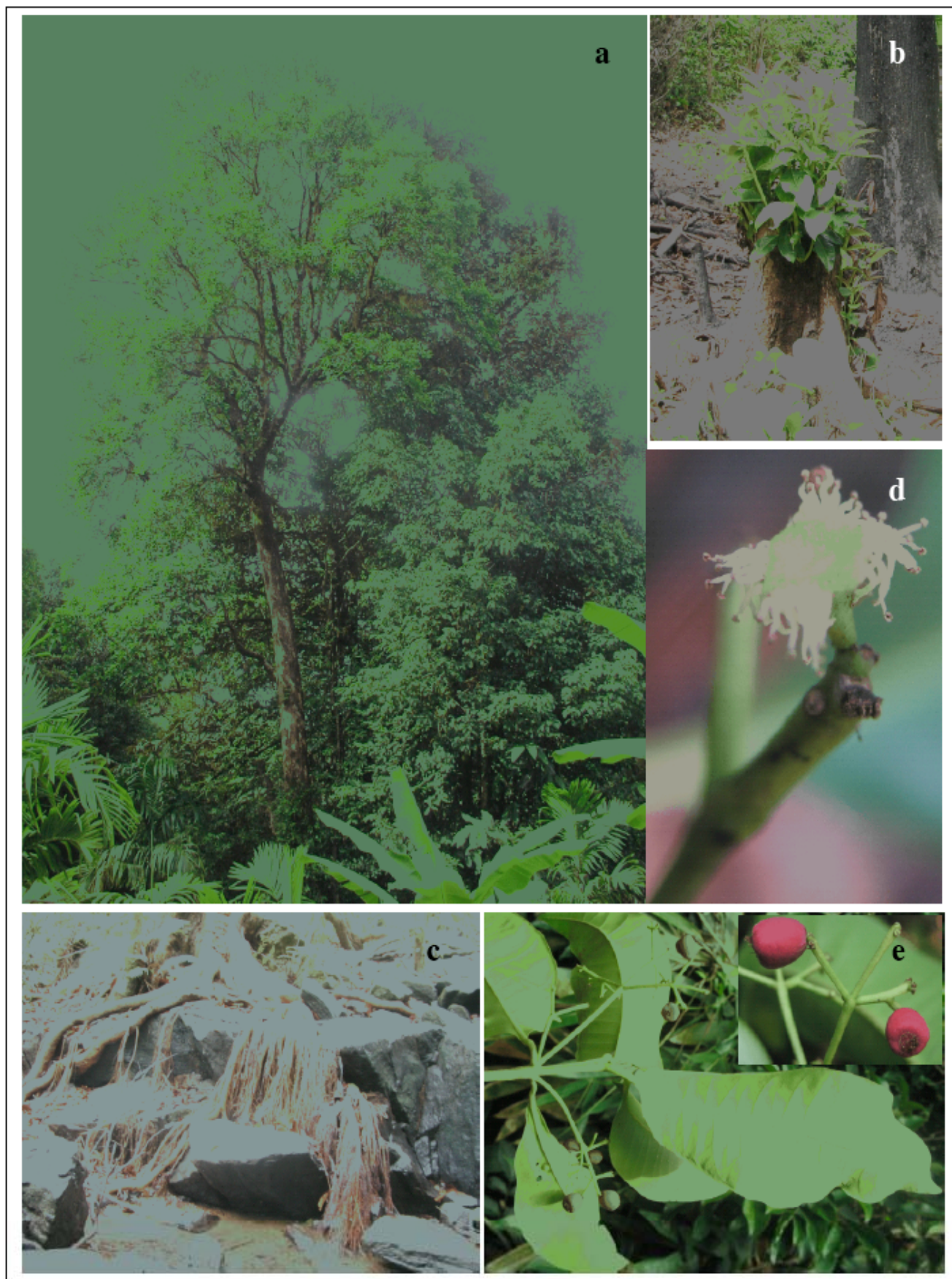


Fig. (4). a) *Syzygium travancoricum* – habit; b) coppicing stump; c) floating water roots; d) a single flower and e) twig with fruits.



Fig. (5). The habitat of *Syzygium travancoricum* – under threat from encroachment.

km. The *Dipterocarpus* patch in Ankola was obviously part of a sacred *kan* forest. A small *Myristica* swamp is also associated with it. Same could be stated about *Syzygium travancoricum*, a stately tree, thought to be extinct once, but rediscovered later, only in southern Western Ghats. Our findings of this critically endangered tree in Siddapur of Uttara Kannada and a single individual in Ankola, in forest patches of ancient antiquity, is very significant. The Siddapur relic forests are also home to recently discovered new tree species *Semecarpus kathalekanensis* [2]. However, biologists should restrain themselves from the general tendency of naming any apparent novel occurrences of plants or animals that they might come across in relic forests as new species; these could as well be the relics of ancient populations or their morphological variants.

The occurrence of *Madhuca bourdillonii* and *Syzygium travancoricum* in Uttara Kannada forests of central Western Ghats, along with *Myristica* swamps and *Dipterocarpus*, clearly goes to prove that low altitude climax evergreen forests with the entire gamut of endemic species of flora and fauna, had more northern ranges for their distribution. Their present day disjunct distribution is largely on account of human impacts on the primeval forests, which have been largely wiped out. Several authors also consider that the current discontinuity of some faunal species in India, might represent relics of a former continuous distribution [34-37]. Karanth [38] considers climatic change and deforestation might be the major causes for present day disjunct distribution and aggregation of the endemic and endangered primate lion-tailed macaque (*Macaca silenus*) in the relics of wet evergreen forest patches of the South Indian Western Ghats.

The view is strengthening among the conservationists about the importance of protecting also smaller patches of forests in the tropics that lie outside large reserves as a substantial number of forest species can persist for decades in fragmented forest [6,38-40]. Inevitably, small fragments will become the last refuges of many rainforest species that are on the brink of extinction, despite the proneness of such populations suffering from depressed reproductive outputs

[41]. It is in some such fragmented forests that we have observed the critically endangered species *Madhuca bourdillonii* and *Syzygium travancoricum*.

What is of grave concern for conservationists is the casual attitude with which the Western Ghat forests are managed, nearly oblivious of their ecological history. Bulk of the primeval forest fragments, in whose conservation the pre-colonial farmers appear to have played key role have perished during the period of modern forestry, whose foundations were laid by the British. Foresters and ecologists should be able to distinguish between relics of primeval forests and advanced stages of secondary successions. Lack of this perception would result in the silent extinctions of scores of endemic species. *Madhuca bourdillonii* in Uttara Kannada is on the verge of extinction on account of unsatisfactory reproduction as well as human and predatory pressures. We are hopeful that more such relic patches with their valuable biota might be in existence in between Travancore and Uttara Kannada.

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