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Eugenia singampattiana Beddome: a critically endangered medicinal tree from Southern Western Ghats, India

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ABSTRACT

Eugenia singampattiana Beddome is an important medicinal plant commonly known as Jungle Guava, restricted to Agasthyamalai phyto-geographical region, in Southern Western Ghats. This species is commonly used in the treatment of asthma, giddiness, body pain, rheumatism and also good source of alkaloids, coumarins and catechins. Due to habitat loss and over exploitation, natural population of the species is depleting at an alarming rate and is already enlisted as critically endangered by IUCN. The present review is focused on distribution, population status, silvicultural aspects and medicinal importance of *Eugenia singampattiana*. Since the species is having high utilization potential with restricted distribution, large scale restoration and *in situ* conservation at species level is an urgent need.

Keywords: *Eugenia singampattiana*, Medicinal tree, Singampatti Hills, Critically Endangered. Southern Western Ghats.

1. Introduction

Eugenia singampattiana Beddome (Myrtaceae) also known as “Jungle Guava” or “Kaattukorandi” (Tamil, Tamil Nadu) is a critically endangered small evergreen medicinal tree (Fig. 1), found at the tail end of Southern Western Ghats regions of Tamil Nadu [1, 18, 24, 27, 28, 33, 36, 42].

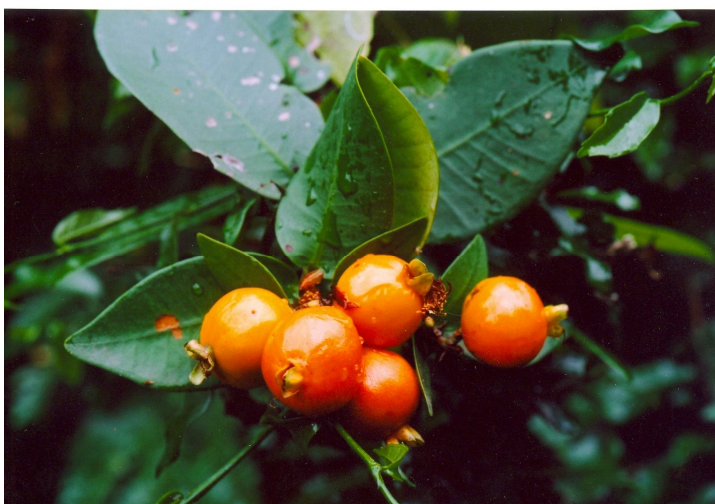


Fig 1: *Eugenia singampattiana* Bedd. Plant with mature fruits

Lushington called this plant as ‘Eugene Myrtle Singampatty hills in Tinnelvely’; the present Tirunelveli District of Tamil Nadu, India [13, 27, 30, 32, 33, 44] which is the type locality of this species. Kannikkar is a group of tribes residing in these forest areas are well aware of the traditional knowledge on the species. After the type collection by Beddome between 1864 and 1874 [5, 13] the plant was rediscovered in 1986 and 1987 by Daniel from Papanasam hills near Hope Lake [15].

This species is categorized as endangered or possibly extinct by Botanical Survey of India [30, 34]. Subsequently this species was located in Chekkalamoode, on the way to Kannikatti from Tulukka mottai [15] and river bank, Inchikuli, Kannikatti and from Ullar to Inchikuli [15]. Sarcar *et al.*, [47, 48] conducted a detailed inventory of this species as a part of developing strategies for the restoration of this species and he could collect the species with flower and ripe fruits on the western side of Hope lake between Kavathalai Ar and Tulukka mottai along the road (lower side) leading to Kannikatti from Kariar in September 1999 and again from the southern side of Hope lake near Banathirham during February and July 2000. Sarcar [46] have also collected various parts of the species and analysed phytogeographic parameters related to growth from places adjacent to the Banathirham waterfalls, Kariar to Kannikatti forest rest house, Inchikuli, Pambar and Mallar river bank during 1999–2001. In 2013, IUCN enlisted this species as Critically Endangered A1c ver 2.3; based on estimated, inferred or suspected population size reduction of $\geq 90\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible based on a decline in area of occupancy, extent of occurrence and/or quality of habitat. Ecologically this species prefers evergreen forest area to semi-evergreen forest areas between 700 and 1500 m through a series of transitions from moist deciduous to evergreen form [48].

1.1 Taxonomical Classification

Kingdom	: Plantae
Division	: Magnoliophyta
Class	: Magnoliopsida
Order	: Myrtales
Family	: Myrtaceae
Genus	: Eugenia
Species	: <i>Eugenia singampattiana</i> Bedd.

2. Description

Dense small evergreen tree, branchlets terete, glabrous, 6-9 m height; bark grey or brownish coloured, smooth, soft, ferrate; leaves opposite, decussate, dark green above, light beneath, 5-12×2.5-8 cm, ovate or elliptic-oblong, nerves 13-15 pairs, nerves and intra-marginal nerve prominent, mid-nerve prominent below, glabrous, base cordate or rounded at base, margin entire, obtuse or acuminate at apex; petiole very short. Inflorescence moderate sized cymes, terminal; bracteoles 2, cymes terminal in short racemes; bracts and bracteoles pubescent, 0.8-1 cm long; pedicels 1 cm long. Flowers bisexual, white, usually persistent, calyx tube nearly globose, sepals 4, oval-orbicular, not produced beyond the ovary, the limb of 4 or 5, persistent lobes, stamens disc broad or absent, calyx tube 3 mm long, lobes 4, sub-orbicular, persistent. Petals 4, bracts and bracteoles pubescent, distinct, glandular, 12 mm long, ovate, inconspicuously dotted and prominently nerved, disc small, stamens numerous, distinct, erect or incurved; filaments 1-1.5 mm long, 2-celled ovary, subglobose, numerous ovules, the cells often again divided by the false partitions, style 8 mm long, ovules several in each cell, stigma simple slender. Fruit berry, spherical or subglobose to globose, 1.5–1.75 cm diameter, yellowish orange-crimson red coloured. Seeds planoconvex, 1.5-1.5×1.3 cm stony black, thick cotyledons.

Flowering & Fruiting: February- October.

3. Distribution

This tree is endemic to the tail end of Southern Western Ghats of Peninsular India [28, 45, 48]. Beddome described this species during

1864-1874 from Singampatti Hills [13, 32] of Tamil Nadu and Daniel collected this species from Papanasam Hills in Tirunelveli. [15, 28]. Rajendran located this species from Chekkalamoode, Tamil Nadu [15]. Thereafter, Gopalan collected it from the Ambalam river bank, Inchikuli, Kannikatti & Ullar, Tamil Nadu [15]. Sarcar and others identified distribution zones in Western Hill Lake in between Kavathalai Ar and Tulukka mottai along the road (lower side) leading to Kannikatti from Kariar [28, 49] and places near to Banathirham waterfalls, Inchikuli, Pambar & Mallar river bank of Tamil Nadu [15, 28, 49]. The distribution range of the species is located between lat. 8°33'N to 8°42'46"N and between long. 77°17'55"E to 77°21'37"E [48] (Map 1). Most of natural distribution points of *E. singampattiana* are adjacent areas with a narrow geographic range having small population size and if the existing habitats are modified this species will be vulnerable to extinction.

4. Ethanopharmacology

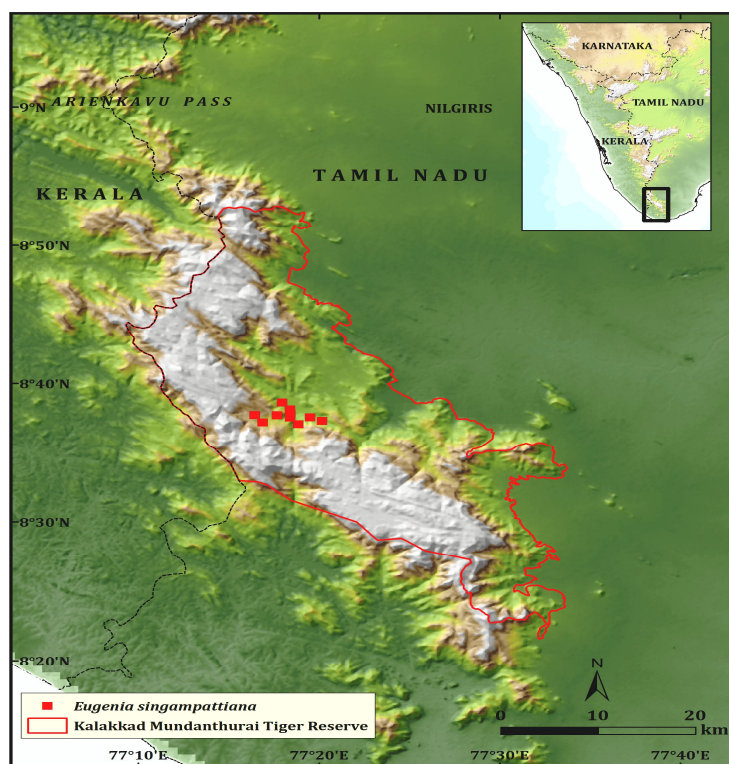
E. singampattiana is known to the Kanikkars, inhabitants of the Agasthyamalai Biosphere Reserve as "*Kattukorandi*"; they use this plant to get relief from toothache, digestive problems, asthma, giddiness, body pain, rheumatism, gastric complaints and also as mouth freshener [2, 4, 6, 25, 32, 36, 43, 48, 54, 57]. A paste prepared from equal quantities of leaves and flowers are consumed to cure body pain and throat pain and tender fruits are consumed to relief from leg sores and rheumatism [24, 31, 36, 48]. A paste is being prepared from equal quantities of stems, leaves and flowers are consumed with palm sugar to get relief from gastric complaints [19, 31, 36, 48].

5. Phytochemical Activity

Compounds like flavanol glycosides, polyphenols, ellagic acids, gallic acids were reported earlier from various species of *Eugenia* [16, 29, 35, 37, 38, 51, 55] and GC-MS analysis of leaves have proved the presence of eighteen compounds [16, 29, 35, 37, 38, 51, 55]. The major identified compound are 5-Methoxy-2,2,6-trimethyl-1(3-methylbuta-1,3-dienyl)-7-oxa-bicyclo heptanes followed by 1,2,3-Benzenetriol (Pyrogallol), α -caryophyllene, 2-propen-1-one, 1-(2,6-dihydroxy-4-ethoxyphenyl)3-phenyl, n-Hexadecanoic acid, 9,12-Octadeca dienoic acid, 2-pentanone, 1-(2,4,6-trihydroxyphenyl) α - Amyrin (β -amyrin), Squalene and limonene [40]. The other compounds like alkaloids, coumarins, catechins, glycosides, flavanoids, phenols, steroids, saponins, tannins, terpenes, sugars, xanthoproteins, derivatives and fixed oils are also reported from *E. singampattiana* [16, 29, 35, 37, 51, 55]. Several studies have proved the significant anti-hyperproteinemia, anti-diabetic, anti-oxidant, anti-inflammatory and anti-hyperlipidaemic effects of this species [21, 22, 25, 46, 52]. Flavonoids are also reported to regenerate the damaged pancreatic beta cells [5, 8, 11] and phenols have found to be effective anti-hyperglycemic agents [8].

6. Antimicrobial and Antifungal Activity

The increase of antibiotic resistance of microorganism to conventional drugs has necessitated the search for new efficient and cost effective ways for the control of infectious diseases, the result of different studies provide evidence that some medicinal plants might indeed be a potential source of new antibacterial agent including this species [17, 25, 38, 40, 47, 53, 56]. The antimicrobial activity of *E. singampattiana* was evaluated on bacterial and fungal strains which can be used to discover bioactive natural products that may serve as leads in the development of new pharmaceuticals for therapeutic needs [9, 10, 12, 20, 22]. The methanol leaf extract showed great activity against different types of fungi like *Candida albicans*, *Penicillium notatum*, *Aspergillus flavus*, *Aspergillus niger* etc. [41, 53].



7. Antitumor and Anticancer Effect

Several studies in *E. floccosa* and *E. singampattiana* exhibit significant antitumor effects [11, 22] with compounds like Octadecadienoic acid, Limonene, Squalene which are anticancerous in nature. Similarly 9-12, Octadecadienoic acid has the property of anti-inflammatory and anti-arthritic as reported earlier [6, 7, 9, 11] and limonene has anti-cancerous, anti-tumoral, antibiotic and anti-protozoal activity [3, 14, 20, 21, 22, 44]. Squalene possesses chemo-preventive activity against colon carcinogenesis [40]. β -caryophyllene is a sesquiterpene that has anti-inflammatory activity [20, 21]. Further investigations into the pharmacological importance of *E. singampattiana* and their diversity and detailed phytochemistry may add new knowledge to the traditional systems of medicine [11, 12, 38, 49, 50].

8. Silviculture and Conservation efforts.

Most of the researches available on silviculture aspects of forestry species in the past were restricted both to common species or commercially important species and in the case of rare and threatened species it is extremely scarce or lacking. The conservation of threatened plants is a great concern because it is suggested that many as half of the world's plant species may qualify as threatened with extinction under the world Conservation Union (IUCN) classification scheme [41]. Hence information on detailed analysis on population structure, range of natural stands, and standardization of nursery practices especially in the case of rare plants is a prerequisite for developing effective restoration strategies.

E. singampattiana is a fire and drought tender shade bearer tree and grows well where soil moisture is ensured with good drainage. The species prefers yellowish brown sandy clay soil and soil parameters related to this species was well studied [48]. The species is not readily browsed by livestock and other wild herbivores. Large numbers of shoots are produced; stumps and also branch cuttings

are used for vegetative propagation. Being a shade bearer during young stage [47] the seedlings and saplings are found under shade of second and first-storied high forest and the species is frost-tender in early stages and hardier later. *E. singampattiana* reported to have excellent coppicing power [47] and number of seeds per kg ranged from 556 to 857 and germination capacity were 84-87%. However, quantified information on natural regeneration of this species is not recorded yet, but much natural regeneration was observed below the tree shade near the streams [47]. Artificial reproduction methods were carried out both from seed origin and by stem cuttings [46, 47]. Since occurrence of this species is strictly restricted to a narrow endemic zone of distribution urgent conservation measures are required to prevent from the imminent danger of extinction. Most of the distribution zones of this species are falling within the protected areas of Tamil Nadu frequent monitoring on regeneration dynamics and phenological patterns can be done in these sites. Similarly habitat suitability and identification of ecological niches is to be done using Ecological niche modelling based on GPS surveys throughout the distribution area which in turn can effectively utilized for identifying potential sites for restoration programmes. The data on seed storage, genetic diversity, reproductive biology, seed dispersal, insects, and diseases is to be generated at the earliest for developing appropriate conservation measures to protect the existing known population of this threatened species.

9. Conclusion

E. singampattiana Bedd. is a critically endangered medicinal tree, endemic to the tail end of Southern Western Ghats, and this species is highly restricted to evergreen patches of Agasthyamalai hills. It is proven as anticancerous, antitumorous, antioxidative, antimicrobial, antifungal, antiinflammatory, antihyperlipidaemic and antidiabetic agents. The tribal people have enormous indigenous knowledge on this particular species which is used for

food and medicinal purposes effectively. *Ex-situ* and *in-situ* conservation strategies are to be developed for this particular species by protecting the existing natural strands and through species specific multiplication and restoration programmes.

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