

# Taxonomic Update and Habitat Status to *Byttneria herbacea* from Peninsular India

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**Abstract** *Byttneria herbacea* is a threatened and endemic species to Indian Peninsular region. It was earlier placed in *Sterculiaceae* and then a separate family *Byttneriaceae*. As per APG classification, it is now treated in family *Malvaceae*. Endemic taxa are usually more vulnerable to anthropogenic threats, natural and climate changes, and therefore hold a higher extinction risk. Taxonomic study on endemic taxa improves a basic understanding for correct identification and description. Habitat and distribution study are essential to get specific information and interpretation on current status and population dynamics of the taxon including niche requirements. It mainly contributes to several branches of applied biology. Frequent botanical exploration work was undertaken to collect the *Byttneria herbacea* in the forests of Peninsular India and it was identified with help of various Floras. The present study provides the information to *Byttneria herbacea*, which includes a detailed morphological description with data on its relevant taxonomic notes, illustration, current distribution patterns with distribution map, habitats, ecological note, population size, conservation status and threats to the selected species. The present study is the first-ever attempt at studying the taxonomic and habitat distribution aspects of *Byttneria herbacea* in the Indian Peninsular region. This study helps for long-term conservation and management plan of *Byttneria herbacea* for foresters and researchers.

**Keywords** *Byttneria herbacea*, Peninsular India, Habitat, Geographical Distribution, Taxonomy

## 1. Introduction

*Byttneria* Loefling, named after David Sigismund A.

Byttner (1724-1768), a physician and botanist at the University of Gottingen, Germany [1]. *Byttneria* Roxb. was first placed in *Sterculiaceae*, then a separate family *Byttneriaceae*. As per Angiosperm Phylogeny Group-APG-IV [2] classification *Byttneria* is now included in the family *Malvaceae* of Malvales clade. The Malvales clade also includes *Malvaceae*, *Tiliaceae*, *Bombacaceae*, *Bixaceae*, *Cistaceae*, *Cochlospermaceae*, *Diegodendraceae*, *Dipterocarpaceae*, *Mutingiaceae*, *Neuradaceae*, *Sarcoalaenaceae* and *Thymelaeaceae* [2-4]. Finding of Judd and Manchester [5], Alverson, *et al.*, [6] and Bayer, *et al.*, [4] has led to the proposal to combine *Sterculiaceae*, *Bombacaceae*, *Malvaceae* and *Tiliaceae* into a broadly defined *Malvaceae* family. Contribution from molecular data, new morpho-anatomical data and progress in methodological approaches has recently led to a new broader concept of this order namely “expanded malvales”. Recent taxonomic treatments group taxa formerly included in “core malvales” in a broader concept of malvales. Additionally, the intra-familial taxonomy has been profoundly modified and in its present circumscription, *Malvaceae* comprises subfamilies e.g., *Grewioideae*, *Byttnerioideae*, *Tiliodeae*, *Bombacoideae*, *Malvoideae*, *Helicteroideae* in 2 main lineages [7].

Hooker [8] initiated taxonomic study of *Byttneria* genus at the Indian subcontinent level and documented nine species of *Byttneria* genus. *Byttneria andamanensis* from Andaman Islands, *B. aspera* and *B. crenulata* reported in Nepal, *B. jackiana* from Penang while *B. elliptica*, *B. uncinata*, and *B. maingayi* from Malaka, *B. pilosa* from eastern Bengal including Burma and Chittagong of Bangladesh [8]. In independent Republic India, the genus *Byttneria* is composed of four species represented by *B. andamanensis*, *B. aspera* (Syn. *grandifolia*), *B. herbacea* and *B. pilosa*. *Byttneria herbacea* occurs in Western Peninsula, Karnataka, Orissa and Konkan [8-9].

## 2. Materials and Methods

Frequent botanical explorations were carried out to document and collect the *Byttneria herbacea*, grown in deciduous forests to moistsemi-evergreen forests of Peninsular India. To know the correct identity of the collected specimens, the Flora of British India by Hooker [8], Flora of India (*Sterculiaceae*) by Malick [9], An Excursion Flora of Central Tamilnadu by Matthew [10], Flora of Maharashtra by Almeida [11], Envis Bulletin, Special habitats and threatened plants of India by Botanical Survey of India (BSI) Government of India, Ministry of Environment, Forest and Climate Change [12] and eFlora of India [13] were referred. *Byttneria herbacea* plant species identified after keen morphological and floral observations and perusal of literature. All relevant data were recorded in a field book along with photographs and herbariums.

## 3. Results

### 3.1. Taxonomic Treatment

*Byttneria herbacea* Roxb., Pl. Coromandel 1:28.1795 and Fl. Brit. India 1:376

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**Synonyms:** *Commersonia herbacea* (Roxb.) G. Don

**Basionym:** *Commersonia herbacea* (Roxb.) G. Don

**Family:** *Malvaceae* Jussieu

**Subfamily:** *Byttnerioideae* Burnett

**Taxonomic note:** *Byttneria herbacea* Roxb. was earlier placed in *Sterculiaceae* R. Salisbury, and then a separate family *Byttneriaceae* R. Brown. As per Angiosperm Phylogeny Group classification [2] the genus *Byttneria* is now treated in family *Malvaceae* Jussieu.

**Taxonomic description:** A branched (rarely unbranched), sub-fruticose, procumbent spreading (up to 30 cm) unarmed herb with a perennial 4 -10 cm long woody root-stock. Leaves simple, alternate distichous, ovate-oblong to ovate-lanceolate, 1.5-6 × 1-3 cm, apex acute to acuminate, base obtuse, rounded or sub-cordate, margin irregularly dentate, sparsely hairy, glabrous beneath; bracts 1-3, subulate, 3-5 veined at base, venation actinodromous, herbaceous, sparsely hairy on both the

surface, with a linear gland at base on lower side of midrib. Petiole 2.5 to 3.2 cm long, slender, sparsely hairy. Stipules 2.2 to 3 cm long, linear to subulate. Flowers bisexual, small, purple in axillary or terminal umbellate cymes. Calyx lobes basally fused, 4 mm, oblong, linear-lanceolate, acuminate, reflexed. Petals 4 mm, red, with long, slender tips and 2 fid appendages. Staminal tube with 5 stamens all with 5 staminoides, fertile anthers with very short filaments, staminodes ovate. Carpel stylocarpellous, stigma and style terete, Ovary pubescent, pentalocular. Capsules 0.8cm across, globose, shortly spiny, septicidally 5-valved. Axile placentation. Seeds 5, one in each locule, 0.5cm long, ovoid, angular, muricate.

**Flowering and Fruiting:** July - January

**Peak Flowering and Fruiting:** October - November

**Life Cycle:** June - January

**Vernacular Names:** Marathi: Madnyakalmeshwar, Pilyamul.

**Oriya:** Samarkhoi, Samarkhai

**Bengali:** Kamraj

**Irula:** Vipuri chedi

**Telugu:** Rudraksha, Yerra katla, Erra teega.

**Tribal:** Dikku sindur, Kamraj rahet.

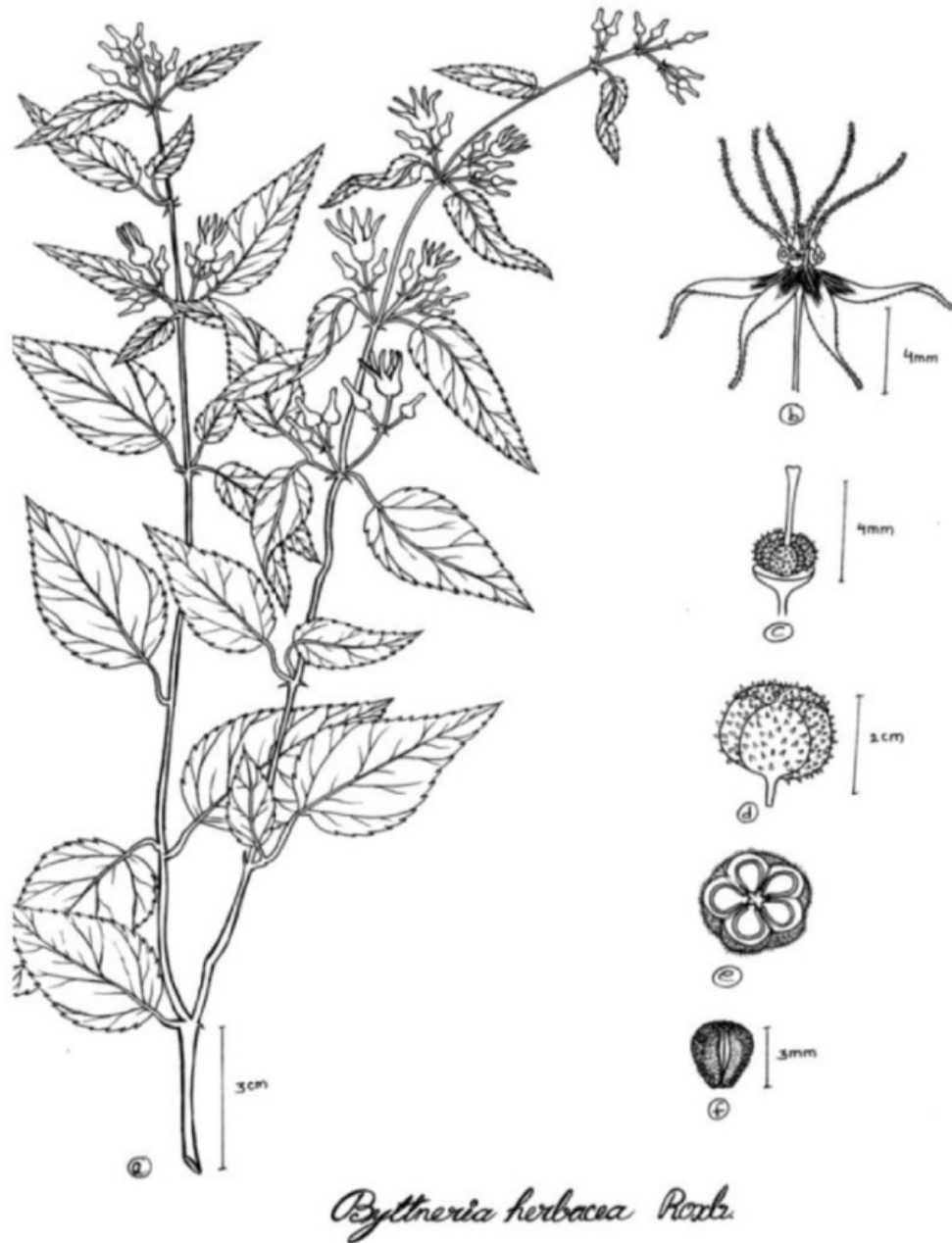
**Propagation:** It is conventionally propagated through both seed and perennial root stock (genet).

### 3.2. Status

*Byttneria herbacea* plant species is threatened and endemic to Peninsular India [12, 15].

### 3.3. Habitat

*Byttneria herbacea* is undergrowth herbaceous and rare species found mostly in scrubby deciduous forests to moist semi-evergreen bush land, often on gallery and woodland forest, stream banks or on termite hills. It is found growing most preferably at rocky terrain on red gravelly soils along the foot hills/slopes or forest edges, under thickets forest from 800-1100 Mt. above sea level. It is fast growing species which takes 1.5 - 2.5 month/s to reach its reproductive stage. It shows narrow and restricted habitat range and localized by forming small cluster of its individuals. In population dynamics study of selected species in Maharashtra state, only 13 pockets of *B. herbacea* with small sub-population and less area of occupancy in its natural habitat have been observed.



**Figure 1.** An Illustration of *Byttneria herbacea* Roxb. a: Habit, b: Flower, c: Carpel, d: Mature fruit, e: T.S of Fruit, f: seed.

### 3.4. Distribution Pattern of *Byttneria herbacea*

**Global distribution:** Envis Bulletin [12] of Wildlife Institute of India, Dehradun, India and Singh *et al.* [15] Botanical Survey of India has recognized *Byttneria herbacea* is an endemic to the Indian Peninsular region.

**Indian distribution:** *Byttneria herbacea* is distributed in Andhra Pradesh, Assam, Karnataka, Kerala,

Maharashtra, Madhya Pradesh, Nagaland, Orissa, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal states of India. The selected species potentially occur in 12 states of India, but in reality, it has become threatened and restricted in very few forest pockets of Peninsular India with less number of occurrences and individuals in its sub-population.

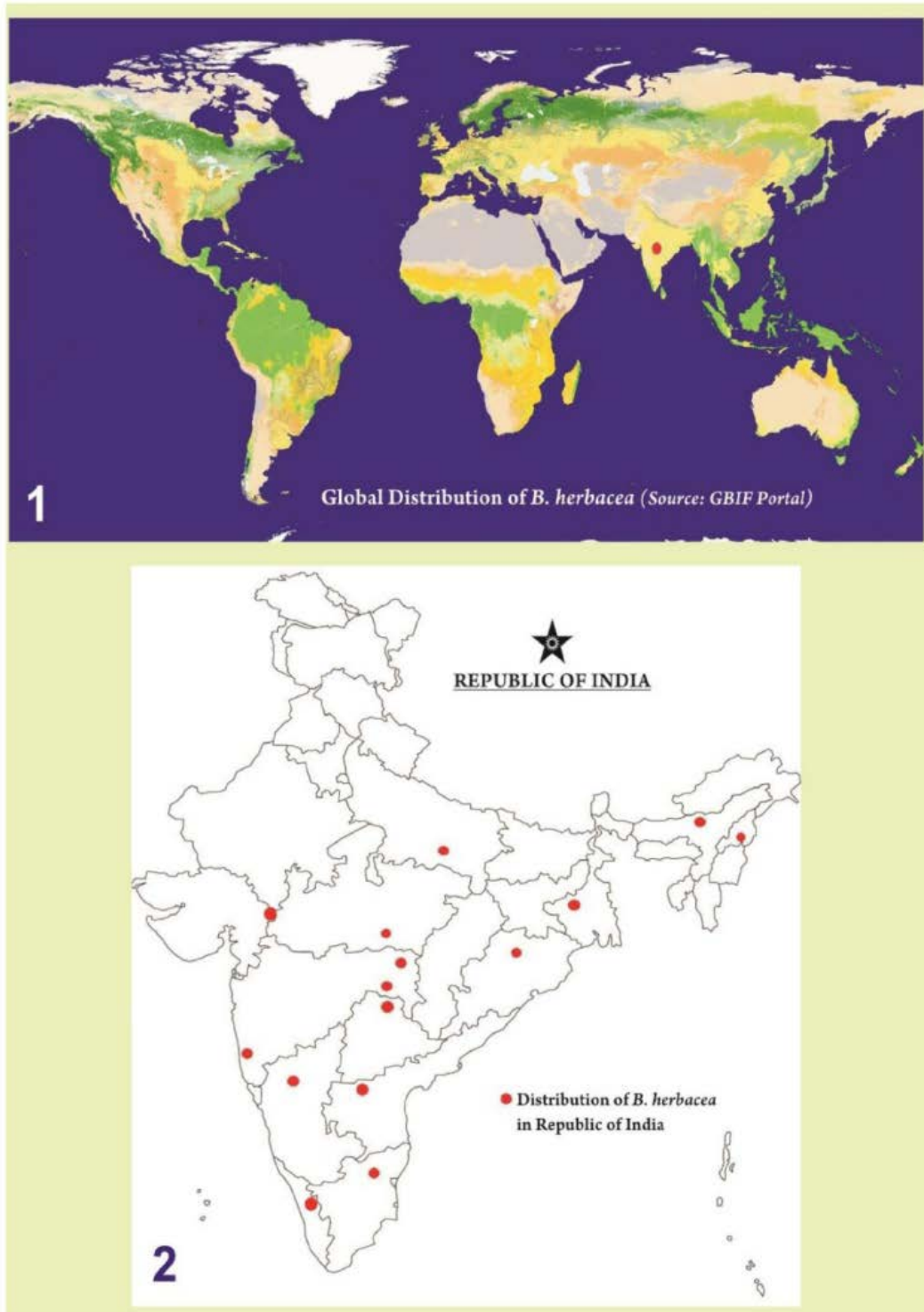


Figure 2. Distribution Pattern of *Bytneria herbacea*

#### 4. Discussions

Endemic plants may actually be competitively inferior to other more widespread taxa [16]. The term endemic has a slightly different definition, depending on the author, e.g. according to Brown and Lomolino [17] when the term endemic is mentioned, it means that it simply does not

occurs anywhere else, while in the same year Peterson and Watson in 1998 [18] stated that we should use endemic only when referring to a taxon that is restricted to a stated geographical region (either in natural or political borders). Since narrowly endemic species are threatened frequently [19] and since areas rich in endemism are more likely to be considered as a rich species area [20]. Narrow endemic

species may harbour significantly lower genetic diversity at the population level than their widespread congeners [21-22]. Hence, endemic species may exhibit reproductive traits likely to reduce outcrossing rates, such as fewer and smaller flowers, less stigma-anther separation and lower pollen-ovule ratios [23-25]. The endemics constitute the foremost group of conservations.

A rare species is one that occurs in widely separated small sub-population so that inter-breeding between sub-populations is seriously reduced or restricted to a single population [26]. They are not at present endangered or vulnerable but face a high risk of being so and usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range [27]. A hypothetical rare species is one with narrow habitat range, low climate tolerance; specialized adaptation requiring an outside agency for pollination, poor dispersal strategies, few seeds per fruit and poor viability of seeds [28]. Distribution study of threatened and endemic plant taxa provides insights for prioritizing such plant species conservation as well as processing the mechanisms of distribution patterns. Site containing national endemic and threatened species is more important for distribution study.

The outputs of floristic modelling and assessment can be used to improve understanding on conservation and protection of threatened plant species over the range in a suitable habitat [29] as well as identification of areas that represent biological species richness and endemic taxa [30]. Study on distribution and status of threatened and endemic species provides valuable data helps in conservation decisions for ecologists and conservationists. The ability to completely sample large areas in order to assess distribution is often difficult, hence smaller sampling areas to be used to make predictions about the distribution of a species over a larger area based on geographic and environmental predictor variables.

*Byttneria herbacea* Roxb. was earlier placed in *Sterculiaceae* and then a separate family *Byttneriaceae*. Edlin [31] divided the family *Sterculiaceae* into two tribes: *Sterculineae* containing only *Sterculia* and *Tarrietieae* which included *Tarnetia* and *Heritiera*. In *Buettneriaceae* Edlin [31] included other genera such as *Pentapetes*, *Melochia*, *Commersonia*, *Buettneria*, *Leptonychia*, *Abroma*, *Pterospermum*, *Helicteris* and *Kleinhouia*. In the broader APG [2] circumscription, *Malvaceae sensu lato* corresponds to the four traditional plant families *Malvaceae sensu stricto*, *Bombacaceae*, *Sterculiaceae* and *Tiliaceae*. Thus, the family *Malvaceae* has expanded to include 250 genera and has been divided into nine subfamilies, one of which is *Malvaceae sensu stricto* [4-5]. These families are closely related to *Malvaceae sensu stricto* but they are not monophyletic groups as shown by

numerous researchers on the Malvales [5, 32-34]. The broad circumscription of the family, as mentioned above, is defined as core Malvales in the Cronquist system. This classification has been adopted by [4, 32-34, 36-37]. Hinsley [38] has put several alternatives for a new classification of *Malvaceae* (core Malvales).

According to Cronquist [39] the order Malvales includes four polypetalous dicotyledonous families such as *Malvaceae sensu stricto*, *Bombacaceae*, *Sterculiaceae* and *Tiliaceae*. Bentham and Hooker [40] have placed *Malvaceae sensu lato*, *Sterculiaceae* and *Tiliaceae* families under the order Malvales. While Hutchinson [41-42] considered that the order Malvales should contain only *Malvaceae* as the order Malvales is more advanced than *Tiliales* and hence the families *Sterculiaceae*, *Tiliaceae* and *Bombacaceae* are treated under *Tiliales*. Bentham and Hooker [40] and Hutchinson [43] have placed the genus *Byttneria* (also spelled as *Buettneria*) under the tribe *Byttnerieae* in *Sterculiaceae* family but Takhtajan [44] has placed it under the tribe *Byttnerieae* of the subfamily *Byttnerioideae* of *Sterculiaceae* family.

Molecular phylogenetic studies (chloroplast *ndhF* gene-aligned length 2226 bp; *rbcL* sequence data) have shown that the traditional dicotyledonous families such as *Malvaceae sensu stricto*, *Sterculiaceae*, *Tiliaceae* and *Bombacaceae* are closely related and thus these families are merged into a more circumscribed family *Malvaceae sensu lato* under the core 'Malvales' (APG-III) [3]. Judd and Manchester [5] studies states that *Malvaceae sensu stricto* is monophyletic in origin while *Bombacaceae*, *Sterculiaceae* and *Tiliaceae* are not monophyletic which supports the view of Edlin [31]. As a result, those genera once placed under *Sterculiaceae* family are treated under subfamilies like *Byttnerioideae*. The members of *Byttnerioideae* clade show (i) a general reduction of stamen number compared to *Grewioideae* and other putative groups (ii) the fertile stamens are gathered into antipetalous fascicles and if staminodes present are antiseptalous and (iii) the petals are broad or concave at their base. Further, the *rbcL* sequence data suggests that the separation of *Byttnerieae* and *Theobromeae* tribes of subfamily *Byttnerioideae* from the rest of traditional *Sterculiaceae* family as predicted by Edlin [31] is accepted by Whitlock, *et al.*, [45], Alverson, *et al.*, [46] and Bayer, *et al.*, [36]. Based on stem structure, vegetative organs, flowers, schizocarpic fruit and spiny pollen grains character, Edlin [31] has created a new family *Buettneriaceae* by dividing the tribes traditionally placed in *Sterculiaceae* into two families: *Sterculiaceae sensu stricto* (*Sterculieae*) and *Byttneriaceae* (remaining tribes). Cronquist [39] however, stated that the *Byttneriaceae* is still quite heterogeneous (in morphology, anatomy, and pollen features) and is paraphyletic or polyphyletic.

**Table 1.** Table showing classification of the Genus *Byttneria* by different authors

	Bentham & Hooker-1862-1883 [40]	Masters-1874 [53] & Hutchinson-1967 [54]	Takhtajan-1997 [44]	Cronquist-1988 [50] & Mabberley-2008 [51]	APG-IV 2016 [2]
<b>Family</b>	<i>Sterculiaceae</i>	<i>Sterculiaceae</i>	<i>Sterculiaceae</i>	<i>Malvaceae</i>	<i>Malvaceae</i>
<b>Subfamily</b>	-	-	<i>Byttnerioideae</i>	<i>Byttnerioideae</i>	<i>Byttnerioideae</i>
<b>Tribe</b>	Buettnerieae	Buettnerieae	-	-	-

Thorne [47] has divided the family *Sterculiaceae* into two subfamilies namely *Sterculioideae* and *Dombeyoideae*. Thorne [47] system gives family status to *Byttnerioideae* and hence the subfamily *Byttnerioideae* is elevated to family level *Byttneriaceae*. Takhtajan [44] has also accepted this classification but he further subdivided these two subfamilies into a series of tribes. But the recent version of the Thorne system [48] takes an intermediate approach in combining *Bombacaceae* and *Sterculiaceae* under *Malvaceae sensu lato*, but retaining *Byttneriaceae* (containing traditional *Sterculiaceae* and *Tiliaceae*) and a considerably restricted *Tiliaceae* as separate families. Whitlock, *et al.*, [49] have considered *Dombeyoideae* as a distinct family *Byttneriaceae*. In fact, the family *Sterculiaceae* is very diverse and is characterized by a great diversity of morphological, anatomical and palynological features, particularly between *Byttnerioideae* and *Sterculioideae*. Since the molecular phylogenetic studies (both *rbcL* sequence data and chloroplast *ndhF* gene analysis) have confirmed that the traditional family *Sterculiaceae* is one among the elaborated family *Malvaceae sensu lato* and the subfamily *Byttnerioideae* is a separate clade in *Malvaceae sensu lato* family where the genus *Byttneria* belongs to and not under *Sterculioideae* clade.

As per embryological observation carried out in the present study, *Byttneria herbacea* has circinotropous ovules. Circinotropous ovules are not observed earlier by any researchers in the of *Sterculiaceae* and *Malvaceae* family members. Therefore, *Byttneria* genus deserves critical analysis for proper taxonomic placement. As per Cronquist [50], Takhtajan [44], Mabberley [51] and Angiosperm Phylogenetic Group [2-3, 52] classification system the family status of *Byttneriaceae* merged under *Malvaceae*. I still support the view of Cronquist [50], Takhtajan [44], Mabberley [51] and APG [2-3,52] classification system.

## 5. Conclusions

Habitat loss and unchecked business of wild endemic medicinal plants is threatening the future of essential resources, as well as the beauty, diversity and natural heritage of our green planet earth. As natural habitats are destroyed or degraded, we lose many unique and precious endemic species of plants every year from the wild habitat. This loss of diversity may also take with it important

cures for diseases-both those face by us now and those that may emerge in the future. Conservation of existing wild habitat of endemic and threatened medicinal plant species are very essential to minimize or avoids the loss of these endemic plant resources. Sustainable use and ex-situ propagation and cultivation methods are already being suggested by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Biological Diversity, the National Center for the Preservation of Medicinal Herbs, International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP), the Medicinal Plant Working Group and other organizations. The present study is the first-ever attempt at studying the taxonomic aspects and habitat distribution study of *Byttneria herbacea* in the Indian Peninsular region. This study helps for long term conservation and management plan of *Byttneria herbacea* for foresters and researchers. Further studies in view of embryological context are likely to yield more comprehensive results to improve fundamental understanding systematics of *Malvaceae* family members.

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