Distinct characters of *Elaeocarpus*, a conservation dependent endemic genus of Western Ghats

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ABSTRACT

The genus *Elaeocarpus* belongs to the family Elaeocarpaceae, it comprises 350 species distributed in the paleotropics. In India there are about 25 species showing disjunct distribution with Northern and Southern group of species. The Southern species of India are endemic to Western ghats. Species of *Elaeocarpus* show some characters which are unique to the genus. At the time of senescence the leaves turn scarlet red, a striking character which is a ready reckoner for the identification of *Elaeocarpus* trees. All the species of *Elaeocarpus* bear flowers during a particular period in a year, however these trees are found to produce flowers in lesser quantity throughout the year. The tree canopies become covered with drooping fragrant flowers during blooming season. Presence of lacinated petals, distinct five lobed cushion, apical extension of the stamen, opening of the anther through an apical slit, etc. are other characteristic features of this genus. Prolate and tricolopolate pollen grains are produced in *Elaeocarpus*. All the floral organs including the cushion are covered with dense hairs. The fruit which is a drupe encloses variously tubercled nut. Species of *Elaeocarpus* distributed in Western ghats have become conservation dependent due to depletion of natural habitat.

Keywords: conservation, disjunct distribution, endemic, lacinated petals, paleotropics, prolate, tricolopolate

INTRODUCTION

Genus *Elaeocarpus* includes about 350 species. It is the largest genus among the two genera of the family Elaeocarpaceae. Family Elaeocarpaceae is placed under the order Malvales [1-3], (www.theplantlist.org.) *Elaeocarpus* is a paleotropical genus, the species are distributed from Madagascar in the west to Fiji and Hawaii in the east. These species grow mainly in temperate, sub-tropical and tropical zones of South Asia, Australia, New Zealand, Chile and West Indies. Forty to forty five species are indigenous to the Indian subcontinent. About 25 species are found in India and are restricted to the two biodiversity hotspots i.e. in Eastern Himalayas in the North and Western ghats in the South. They show disjunct distribution, the species found in Eastern Himalayan region are not observed in the Southern Western ghats and are separated by a relatively dry zone of the Deccan. About half of the Indian species are distributed in the South and these are endemic to the Western ghats [3-6].

Western ghats is 1,600 Km long chain of mountains which runs along Arabian Sea in the west coast of India from north to south. It is one of the 34 biodiversity hot spots of the world and one of the world's eight 'hottest hotspots' of biological diversity. It is recognized as World heritage site by UNESCO due to the most important and significant natural habitats for in-situ conservation of biological diversity and endemism [4-6]. In Western ghats the species of *Elaeocarpus* are often

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found distributed in swamps along with the species of *Garcinia, Hopea, Myristica, Syzygium*, etc. (7).

MATERIALS AND METHODS

Information regarding the distribution of *Elaeocarpus* species was collected from relevant literature and reviews [1,3,7-19]. Information was also collected from the herbaria at Pune (BSI), Coimbatore (MH), GKVK, Bangalore (UASB), Mysore University Herbarium, Mysore and Yuvaraja's college Herbarium (YCMUOM). Field surveys were conducted during the year 2010-2013. Plant specimens were collected at reproductive stages from their natural habitat at regular intervals. In each year 6-8 visits were made to different locations. Collected specimens were identified with the help of local Floras [3,8-13,16-22]. Plant names were cross checked by referring recent taxonomic literature and Kew data base [2], (www.theplantlist.org.) IUCN website was referred for documenting the threatened categories of these species (www.iucnredlist.org). Standard methods were followed for the preparation of voucher specimens [23]. Specimens were deposited in the herbarium at Yuvaraja's College, University of Mysore (YCMUOM).

RESULTS AND DISCUSSION

Literature survey and information gathered from the herbaria showed the presence of twelve *Elaeocarpus* species and two varieties of *E. serratus*: *Elaeocarpus blascoi* Weibel, *Elaeocarpus ferrugineus* (Jacq.) Steud., *Elaeocarpus gaussenii* Weibel, *Elaeocarpus lanceifolius* Roxb., *Elaeocarpus munronii* (Wt.) Mast., *Elaeocarpus oblongus* Gaertn., *Elaeocarpus recurvatus* Corner, *Elaeocarpus serratus* L., *E.serratus* L.var. *serratus* Zmarzty, *E. serratus* L. var. *weibelii* Zmarzty, *Elaeocarpus tectorius* (Lour.) Poir., *Elaeocarpus tuberculatus* Roxb., *Elaeocarpus venustus* Bedd., *E. variabilis* Zmarzty [3,7-19]. Among the above 12 *Elaeocarpus* species, *E. gaussenii* is critically endangered (CR), *E. blascoi* is endangered (EN), *E. recurvatus* and *E. venustus* are vulnerable (VU) and *E. munronii* is Lower risk (LR) threatened status. Remaining seven species are yet to be assessed for the IUCN Red list status (www.iucnredlist.org).

Genus *Elaeocarpus* shows some unique characters which distinguish them from other group of plants. All the species of *Elaeocarpus* found in Western ghats are evergreen trees. Though all these species are mostly found in the seasonally flooded swamps of Western ghats, distribution pattern differs among the species of this genus, *E. serratus* var. *serratus* and *E. munronii* are often found along the fringes of evergreen forests, *E. serratus* var. *weibelii* and *E. variabilis* in slopes, *E. tuberculatus* on the river banks and streams or near the source of water. Though the study is based on the species distributed in the Western ghats, the characters mentioned in this study applies to remaining species distributed elsewhere.

Members of the genus *Elaeocarpus* are readily recognizable by the presence of red leaves in their canopies. At the time of senescence the mature leaves turn scarlet red in colour. This striking character could be used as a ready reckoner for the identification of *Elaeocarpus* species (Figure 1B). Monopodial type of branching is common in the species of *Elaeocarpus* but in some species, viz. *E. recurvatus* and *E. tuberculatus* 'Aubreville's model' of branching is present, i.e. branches are produced in whorls. Such branching gives gracious appearance to these trees; such trees could be grown to improve aesthetic beauty. Leaves are close alternate and are clustered at the tip of the branches giving spiral appearence, which is termed as pseudo whorls. Petiole of the simple leaves is swollen at both the ends. Huge trees of *Elaeocarpus* species produce buttresses and gives additional support to the tree trunk (Figure 1A).

All the species of *Elaeocarpus* produce flowers profusely during October to April, however they are found to produce flowers in lesser quantity throughout the year. During the flowering season, the tree canopies become covered with drooping white or pale yellow fragrant and attractive flowers (Figure 1G). The flowers are borne on racemes at the axils of each leaf, after the shedding of leaves the basal racemes become exposed. In the flowering season the trees are buzzing with visiting pollinators like honey bees, insects and birds. Mathews and Endress [24] suggests 'Buzz pollination' tend to be associated with such pendulous flowers with short stamens and apical opening of anthers. All the floral parts are covered with dense, transparent and glossy hairs. Flowers are bisexual and pentamerous. Rarely tetramerous and hexamerous are also found among the pentamerous flowers.

Presence of lacinated petals is a peculiar character of *Elaeocarpus*. These fringed petals make the flowers more attractive. More than half length of the petal, towards the upper part is repeatedly dissected. Each petal is divided into 2-3 main lobes, which is further cleaved into many narrow and delicate tapering segments. Petal is more or less trapezoid shaped, with narrow base and wider apex (Figure 1C). Petals shed earlier than other floral organs.

Inner to the whorl of petals, prominent five lobed, dark yellow-orange colour cushion or disc is present (Figure 1E). It is covered with short dense hairs which gives velvet look to the cushion. Lobes of the disc are placed alternating with the petals, each lobe is chordate shaped. Cushion in *Elaeocarpus* species may be involved in the secretion of fragrant nectar.

Stamens are arranged along the inner side of the cushion. Androecium is another added attraction of *Elaeocarpus* flower. Each petal encloses a group of stamens at young stage. As the flower opens, the stamens become exposed. Number of stamens vary in different species, it ranges from 25 to 70 and arranged in 5 groups (Figure 1D). Unlike in most of flowering plants the filament of the stamen is very short ending with a long dithecous anther. In *E. variabilis* sigmoid shaped filament is present. An unusual character of *Elaeocarpus* is the presence of one or the other form of apical extension of the anther. It is in the form of short and transparent extension in *E. variabilis*. In *E. tuberculatus* and *E. munronii* the connective extends in the form of a single bristle. In the two varieties of *E. serratus* a tuft of transparent, prominent glossy hairs are present (Figure 1F) A unique type of anther dehiscence observed in the species of *Elaeocarpus*, at the time of maturity, two anther lobes get separated from each other at the apex resulting in the formation of a transverse apical slit, the slit continues downwards and exposes the pollen grains (Figure 1F). The prolate and tricolopolate type of pollen grains are unusually small in size [1].

Ovary is 2-3 loculed with more than one ovule in each locule, ovules are arranged on axile placentation. At maturity only one locule and a single ovule matures and remaining locules along with the ovules get aborted. Fruit is a drupe, size and shape of the fruit varies in different species. It is more or less globular (*E. tuberculatus*, *E. serratus* var. *weibelii* and *E. venustus*), oblong (*E. variabilis* and *E. munronii*) or obovate (*E.serrtus* var. *serratus*). Ripe fruit remains green in most of the species, in *E. munronii* the ripe fruit turns prussian blue. Fruits of some species are edible (*E. munronii* and *E. variabilis*), fruits of all the Western ghats species are eaten by ungulates. Fleshy part of the fruit encloses a tubercled nut which has hard shell formed by the stony endocarp (Figure 1H:a-g). The sculpturing on the endocarp varies in different species. Shape of the nut corresponds to the shape of the fruit except in *E. tuberculatus* where the nut is compressed laterally.

Nuts of *Elaeocarpus* have low dispersal ability and are dependent on frugivorous animals. The animals consume the whole fruit, passing through their digestive tract is believed to facilitate the germination process. As the animal population is decreasing due to deforestation and poaching, the fruits remain under the tree and the nutritious seeds are eaten by the rodents [25]. This is one of the reasons for decreasing population of *Elaeocarpus* species.

Figure 1. A. Butresses of *Elaeocarpus tuberculatus*; B. Branch of *E. serratus* var. *serratus* showing mature red leaves; C. *E. serratus* var. *serratus* flower; D. Androecium of *E. tuberculatus*; E. Gynoecium of *E. munronii* on the cushion; F. Stamen of *E. serratus* var. *serratus* showing apical tuft of glossy hairs; G. Inflorescence of *E. tuberculatus*; H. Nuts of *Elaeocarpus* spp.: a. *E. variabilis*, b. *E. serratus* var. *weibelii*, c. *E. serratus* var. *serratus*, d and e. *E. tuberculatus*, f. *E. lanceifolius*, g. *E. munronii*.

Biodiversity of Western Ghats is depleting at an alarming rate due to anthropogenic interference. Habitats with rich biodiversity, rare and endemic species are severely affected by such activities [26]. Endemic species are more prone to become endangered and extinction [27]. Hence these species have become conservation dependent.

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