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PGR NOTE

Occurrence of *Artocarpus hirsutus* Lam. (Wild Jack) in Central Western Ghats: Habit, Habitat and Associated Traditional Knowledge

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The wild jack, *Artocarpus hirsutus* Lam. is an endemic keystone tree species of Western Ghats. The tree has significant uses as timber, medicine as well as providing ecosystem services. Fruits and seeds are also consumed. Exploration trips were conducted in the Central Western Ghats to understand the occurrence, habitat, habit, community importance and traditional knowledge associated with wild jack. In addition to the natural occurrence at various altitudes of Ghats, the wild jack trees were found to be conserved in typical community forest habitats called *Kaan* Forests. During the exploratory visits across two districts of Karnataka state, Uttara Kannada and Shivamogga, a total of 63 fully grown trees, located at 13 sites were tagged, for further genetic and biochemical studies.

Key Words: *Artocarpus hirsutus, Kaan* forest, Western Ghats, Wild Jack

Introduction

The Western Ghats, a biodiversity hotspot in India, extend from North to South viz. Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, Kerala (Daniel, 1997), running parallel to the West Coast of Peninsular India for about 1,600 km covering a biodiverse region of 160,000 km^2. This phytogeographical region is known to sustain more than 7000 species of flowering plants in the region with 5,588 indigenous species and 1,273 endemic species exclusively confined to the Western Ghats. (Nayar *et al*., 2014). *Artocarpus hirsutus* Lam. (Moraceae), commonly known as Wild jack, is one of the endemic tree species of Western Ghats (Ahmedulla and Nayar, 1986), having edible fruits and quality timber. Genus *Artocarpus,* represented by *A. heterophyllus* Lam. (Jackfruit), *A. altilis* Parkinson (Breadfruit), *A. hirsutus* Lam. (Wild jack), *A. integer* Merr. (Cempedak), *A. lakoocha* Roxb. and *A. camansi* Blanco., is a storehouse of minerals, vitamins, antioxidants and other nutrients as well as valuable source for medicinally important compounds. Wild jack was recorded in '*Hortus Indicus Malabaricus*' in 1682 (Manilal, 2003). *A. hirsutus* is the only endemic species among 18 *Artocarpus* species reported in India and the tree is categorized as Keystone Species of Western Ghats (Nayar, 1996). Wild jack is reported to be geographically restricted to the Western Ghats from the *Kalinadi* river of Maharashtra State in the north to the *Agasthyamala* in Thiruvananthapuram district of the Kerala State in the south (Ramesh and Pascal, 1997). The tree is reported to be distributed from sea level to 1000m altitude where there is an average annual rainfall of 1500mm with sandy and rocky soils (Mathew *et al*., 2006). Wild jack, also known as Hairy Bread-Fruit Tree, is variously called vernacularly as *Pat Panas* in Marathi and Konkani; *Hebbalasu* in Kannada; *Anjili* or *Ayani* in Malayalam and *Aiyinipala* in Tamil.

In addition to the well documented saline resistant timber value of *Ayani wood* for traditional boat and house building (Jagtap *et al*., 2010) and folk medicine (Jarret*,* 1959), medicinal properties of wild jack has been reported for antibacterial activity (Shobana *et al.,* 2020), anti-acne activity (Nayak *et al*., 2018) and anti-ulcer activity (Dibinlal *et al.,* 2013).

Mathew et al (2006) have provided comprehensive description of wild jack tree in the Malabar Coast along with its indigenous biocultural diversity among the

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folk communities of the region. However, details of occurrence, community involvement in conservation, nutritional value, extant traditional knowledge and use of wild jack in Central Western Ghats remains scarcely documented. At present, most of the knowledge is anecdotal particularly in natural sites of Karnataka. In order to identify the sites and trees for detailed genetic and biochemical studies, exploration trips were undertaken to Western Ghats of Karnataka. Here we provide a brief report on the occurrence, habit, habitat and associated traditional knowledge of wild jack in Central Western Ghats.

Exploration Sites and Sample Collection

Central Western Ghats area was explored (Table 1) with a focus on *Kaan* Forests. *Kaan* forests, often situated contiguous with villages, are forest territories recognized as *sacred and protected* on the grounds of religious and cultural beliefs. *Kaan*, literally meaning 'thick evergreen forests', have existed in the Central Western Ghats for millennia (Joshi and Gadgil 1991). *Kaan* forests, ranging in size from a hectare to many hectares, act as safety forests or reserve forests of local people (Gokhale *et al*., 2011). Being least disturbed, these forest territories harbour threatened, endemic and relic tree species (Joshi and Gadgil 1991). Area selected for exploration was near Gubbigadde village famous for *Appiko* movement of 1983 (Hegde and James 2018).

Exploration was conducted during March-May, 2017 in fruiting period at 13 sites in two districts of Karnataka state- Uttara Kannada and Shivamogga (Table 2; Fig. 1). Each site was considered as a sub-population and was represented by randomly identified 8-10 trees. Sites one to eight were from *Kaan* forest and rest of the sites were from the wild along the mountain passes of Kundadri *Ghat* and Agumbe *Ghat*. Sixty-three fully grown (22-40 years old) trees were tagged for the collection of leaves, fruits and seeds (Table 2).

Table 1. Passport data information of exploration sites

S.No.	Factors	Details
1	Collection site	Disturbed wild, natural wild
2	Status	Wild
3	Frequency	Occasional, frequent, abundant
4	Sampling	Random (7-8 tree per each sub-population)
5	Habitat	Disturbed, partially disturbed
6	Cultural practices	Rainfed
7	Soil type	Red loamy soil, loam to lateritic, hilly type soil /lateritic soil
8	Topography	Plain, undulating, hilly, steeply dissected
9	Forest type	Semi-evergreen to evergreen
10	Annual Rainfall	2500 mm to 3300 mm

Habitat

Typically, collection sites exhibited a common three-layer structure (Fig. 1). Lower layer having a pond for water conservation; middle layer with human habitation and integrated agriculture; and outer layer of *Kaan* forest. Trees were luxurious in terms of height, girth size and fruiting. The trees often supported sciophytes and climbers. Many common co-occurring trees (*Saraca asoca* (Roxb.) W.J.de Wilde, *Syzygium cumini* (L.) Skeels., *Albizia lebbeck* (L.) Benth.*),* shrubs (*Lagerstroemia parviflora* Roxb.), herbs (*Dendrocalamus strictus* (Roxb.) Nees, *Bambusa arundinacea* (L.) Voss), climbers (*Piper hookeri* Miq., *Canavalia ensiformis* (L.) DC., *Jasminum malabaricum* Wight.) etc. were observed as associated vegetation. We observed various degrees of habitat destruction in and around the *Kaan* forests.

Table 2. Site details of wild jack trees in Central Western Ghats of Karnataka

S. No.	Site (Village, Taluk, District, Latitude, Longitude, Altitude)*	No. of trees tagged
1	Kannigeri-Haliyal Cross, Yellapur, Uttara Kannada (14.999 and 74.723, 556m)	7
2	Yekkambi, Sirsi, Uttara Kannada (14.697 and 74.938, 655m)	7
3	Bhedasgaon, Mundgod, Uttara Kannada (14.736 and 74.951, 584m)	7
4	Chitrahattihalli, Sorab, Shivamogga (14.408and 75.079, 629m)	3
5	Thavanandi, Sorab, Shivamogga (14.452 and 75.092, 614m)	7
6	Navanageri, Sirsi, Uttara Kannada (14.560 and 74.939, 573m)	11
7	Kugve, Sagar, Shivamogga (14.169 and 74.982, 590m)	4
8	Jambagar, Sagar, Shivamogga (14.15 and 75.081, 600m)	3
9	Kowrihaklu-Agumbe, Tirthahalli, Shivamogga (13.53 and 75.105, 671m)	3
10	Agasanakone, Tirthahalli, Shivamogga (13.511 and 75.122, 652m)	1
11	Kundadri Ghat, Tirthahalli, Shivamogga (13.552 and 75.171, 733m)	5
12	Nantur-Kundadri Ghat, Tirthahalli, Shivamogga (13.541 and 75.157, 622m)	3
13	Honnetalu, Tirthahalli, Shivamogga (13.567 and 75.14, 662m)	2

* Please see Fig 1 for map

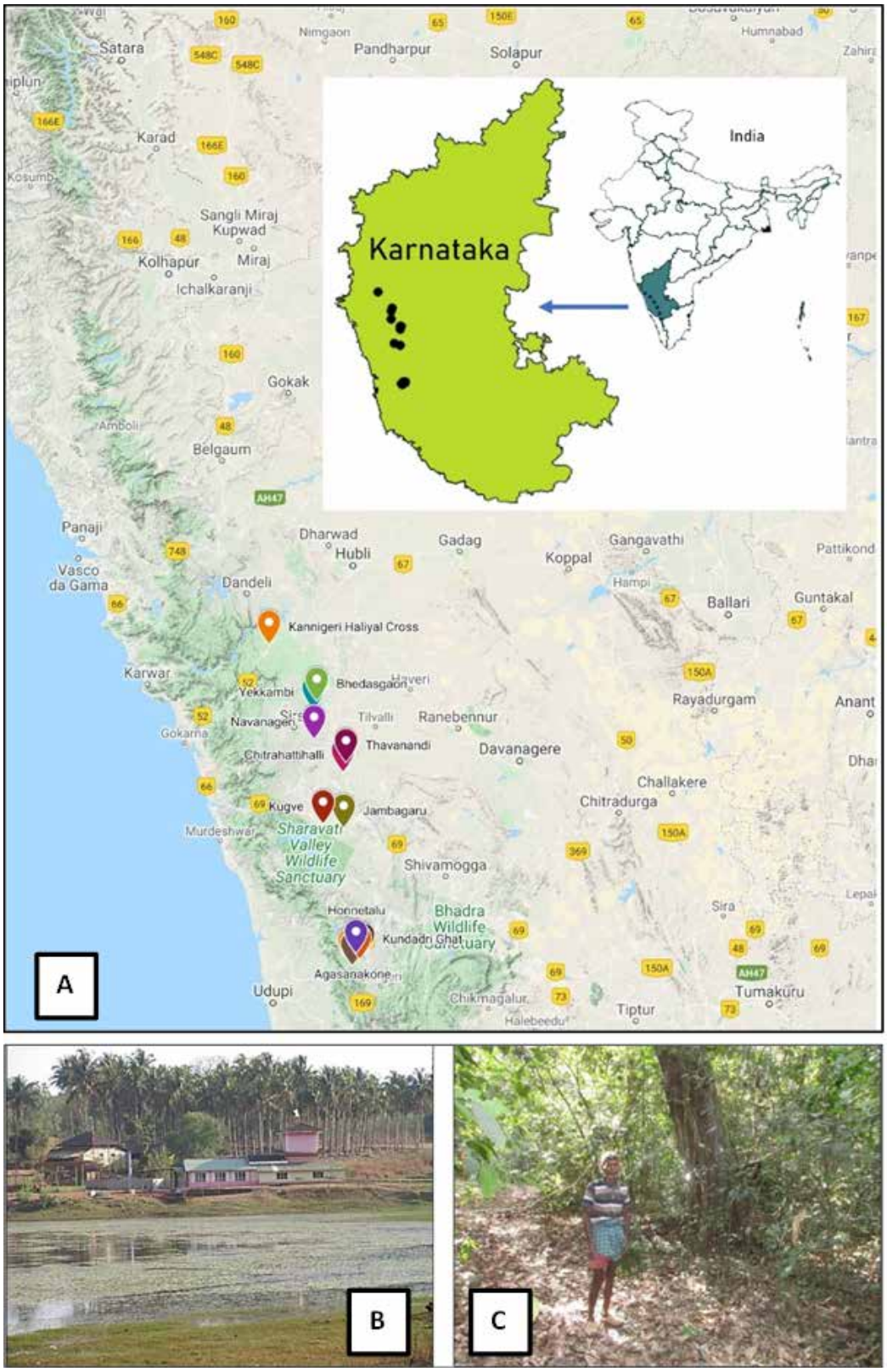

Fig. 1. Wild jack exploration sites in Central Western Ghats (A) Site map (generated using Google Maps; See Table 2 for details). Representative exploration site with (B) A typical three-layer structure habitat and (C) A local farmer inside the Kaan forest of Navangeri, Sirsi, Uttara Kannada distrcict of Karnataka.

Habit

Flora of Southern India, Peninsula and specifically Karnataka have described the tree in detail (Rao *et al.,* 2014). Mature wild jack trees were found to be 30 to 35m in height and 4 to 5m in girth. Trees in *Kaan* forest were branched with lesser trunk size against straight, taller and stouter trees found in reserve forest. Essentially as per the descriptions found in India Biodiversity Portal (https://indiabiodiversity.org/species/show/8066), mature trees had scaly bark with white sapwood and yellow-brown heartwood. White profuse latex was common. Simple alternate leaves were broadly elliptic and found to be clustered at the end of the twigs. Petioles, stipules and young leaves were typically hirsute. Wild jack possessed typical *Artocarpus* unisexual flowers and bore typical compound fruits of variable size and shapes (spherical, ovoid or irregular) with prickly surface. Green immature fruits turned to orange-yellow when ripe. Overall, the fruit was similar to a jackfruit in anatomy. Non-albuminous seeds were arranged around the core and had smooth white surface.

Traditional Culinary and Curative Knowledge

Use of leaves to treat joint pains and leaves crushed with turmeric to treat chronic haemorrhage as recorded by Rheede (Manilal, 2003) could not be confirmed. Unripe fruits are consumed as vegetable (Hegde *et al.,* 2015) and processed in salt or sugar. Fleshy pulp is used for *papad* making. Fully ripe sweet-sour fruits have pleasant aroma and are consumed as fresh fruits. Roasted, dehusked and salted seeds are eaten as snacks. Flour of Sun-dried seeds is occasionally mixed with rice flour in the preparation of *idli* and *dosa*. Seed flour could be added to *sambhar* and *chutney*. Kernels boiled in water produces oil. The oil is rarely consumed but used to treat skin ailments. Known use of wild jack seed as appetite stimulant (Agrawal, 1986) was not confirmed. Medicinal properties of bark, mixed with coconut oil, to treat tinea (Dhobi's itch), bone fractures in animals and snakebite (Geetha *et al.,* 1996; Parinitha *et al.*, 2004) were confirmed.

Discussion

Central Western Ghats area explored by us revealed several patches of community forest called *Kaan* forest or *Devara Kān* or *Devara Kādu* (sacred forest). Local people and Forest Department together maintain *Kaan* forests. Inventorization and comparative description of tree diversity of the *Kaan* forest are being conducted by College of Forestry of Sirsi affiliated to the University of Agricultural Sciences, Dharwad. Our exploration recorded that wild jack trees werewidely distributed in *Kaan* forests. In some cases, potential importance of wild jack to the local economy has been shown to be as high as 33% *Total Importance Value* (an index that combines density, frequency and dominance), which was comparable with 37% in case of jackfruit (Gunaga *et al.,* 2012). Importance of wild jack is determined by its multipurpose utility, where its wood, leaf, bark, fruit and seeds are integral part of the routine life of locals. Despite such an array of uses, researchers have recorded at best historical benchmarks for management of Kaans (Ramachandra *et al*., 2013); but we could find no literature on the efforts to domesticate wild jack in Central Western Ghats. Our survey did not detect any evidence of disease or pest infestation on the wild jack trees.

Although no specific study about genetic erosion of wild jack has been reported, case studies have reported biodiversity loss in *Kaan* forests. Ramachandra *et al*. (2013) have documented the serious effects of Non-Timber Forest Product of contract to non-locals. Logging in the Kaan for timber and fuel and encroachment of Kaan particularly by coffee estates have been listed as the major reasons for genetic erosion. Majority of the explored *Kaan* forest sites had a typical three-layer structure habitat. The layers, wherever observed, were apparent. However, the spatial extent varied depending upon the undulation of the topology and the size of the human inhabitation. No literature describes a tri-layered habitat adjacent to *Kaan*. It was obvious that the sites that continued to possess *Kaan* forests were the ones that ensured sustainable use of the forest produce. Conceivably, human inhabitation nearer to the Kaan meant that locals had a constant oversight on the activities of the contractors engaged by the revenue department. However, studies on the quantitative contribution in terms of ecosystem services of Kaan vis-à-vis reserved forests can throw light on the implications of layered architecture.

Genomes of three *Artocarpus* species, jackfruit (*A. heterophyllus*), breadfruit (*A. altilis*) and breadnut (*A. camansi*) are sequenced opening the avenues of gene prospecting. Cempedak (*A. integer*) has been studied in detail as an underutilized fruit tree crop (Wang et al 2018). Phylogenomics (Gardner *et al.,* 2019) and genome sequencing (Sahu *et al.,* 2020) of various *Artocarpus*

species are in the advanced stage but no clear information on population genetics as well as biochemical profile of the edible parts in case of Wild Jack. *A. hirsutus* being an endemic keystone species of India demands more scientific investigations to achieve commercial success in pharmaceutical and nutraceutical industry.

Forest products of *Kaan* forest viz. fruits, timber of felled tree, gums, and spices are auctioned or distributed among the community with consensus. Sustainable commercialization is expected to add great economic value to these products. In recent times, exotic fruits particularly from South East Asia, are in great demand. Strangely, local and endemic wild jack with tasty ripe fruits finds no place in the niche upmarket stalls. Undervaluation of plant genetic resources puts an acute opportunity cost on conservation of their habitats. Need of the hour is comprehensive biochemical profiling of wild jack to facilitate value addition to the products; detailed population genetic analysis to support *in situ* conservation efforts, and to identify plus trees for traits of economic importance.

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