



Biodiversity in sacred urban spaces of Bengaluru, India

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ABSTRACT

Urban green spaces provide critical social and ecological support for cities, but we know little about their diversity and composition in cities of the Global South. This is especially true of lesser known urban spaces such as sacred sites, which are of important cultural and biodiversity significance. We examine tree diversity and composition in sacred sites in Bengaluru, one of India's fastest growing cities. We recorded 5504 trees from 93 species across 62 temples, churches, and Hindu, Christian and Muslim cemeteries in central areas of Bengaluru. Over half (52%) of the tree species were of native origin, a much higher proportion when compared to other green spaces in the city such as parks. Tree density in sacred sites was much higher than that in parks and informal settlements in Bengaluru. Temples and Hindu cemeteries contained the highest proportion of native species, with large numbers of *Ficus benghalensis*, a keystone sacred species. Trees in sacred spaces provide an important buffer against urban environmental stress in Indian cities, and serve as refuges for urban wildlife and biodiversity. We need greater information on these lesser known, but culturally significant alternate spaces. They play an important, though ignored role in the environmental sustainability of rapidly growing cities in the Global South.

1. Introduction

The human impact on the planet today is perhaps most visible in its cities – especially so in Asia, which has the highest number of urban residents. Urbanization threatens biodiversity and environmental sustainability (UN-Habitat, 2016). Urban land area expansion is taking place even faster than urban population growth (Seto et al., 2011, 2012), resulting in the fragmentation of urban green cover and loss of urban biodiversity (Elmqvist et al., 2013).

Urban green cover provides multiple benefits to city residents (Dearborn and Kark, 2009; Shackleton et al., 2015), including the mitigation of urban heat island effects, reduction of air and noise pollution, and protection against flooding (The Nature Conservancy, 2016). Food trees in urban public spaces can provide economic and food security benefits (Lafontaine-Messier et al., 2016). Foraging in urban forests supplies medicine and supports livelihoods (Clark and Nicholas, 2013; Poe et al., 2013; McLain et al., 2012, 2014; Shackleton et al., 2015). Urban biodiversity provides important recreational and aesthetic benefits, and is especially important for physical and mental health (van den Berg et al., 2015).

Urban green spaces include the more obvious parks, domestic

gardens and remnant forests patches. They also encompass lesser known informal spaces such as streets, pavements and land next to water bodies (Rupprecht and Byrne, 2014). In addition, green spaces of religious and cultural significance are especially significant in many countries of the Global South. These include heritage trees in Buddhist shrines of Bangkok city, Thailand (Thaiutsa et al., 2008), to sacred trees in Bengaluru, India (Nagendra, 2016; Keswani, 2017), and trees in churchyards and cemeteries of Grahamstown, South Africa (De Lacy and Shackleton, 2017a).

Sacred urban ecosystems serve a dual purpose: they support biodiversity, and are of cultural significance to urban residents (Kowarik et al., 2016). Sacred sites in Indian and other Global South cities can serve as an important node and motivation for conservation (Nagendra et al., 2013; De Lacy and Shackleton, 2017a,b). Several species of *Ficus* – especially *Ficus religiosa* and *Ficus benghalensis* – are considered sacred in Hinduism and Buddhism. *Ficus religiosa* is associated with Gautama Buddha, the founder of Buddhism, believed to have attained enlightenment under the shade of a *Ficus benghalensis* (Nene 2000). *Ficus religiosa* is found in Hindu temple compounds across India, and is also ubiquitous on roadsides where it is worshipped along with *Azadirachta indica* (Krishna and Amirthalingam, 2014; Keswani, 2017). The wood of

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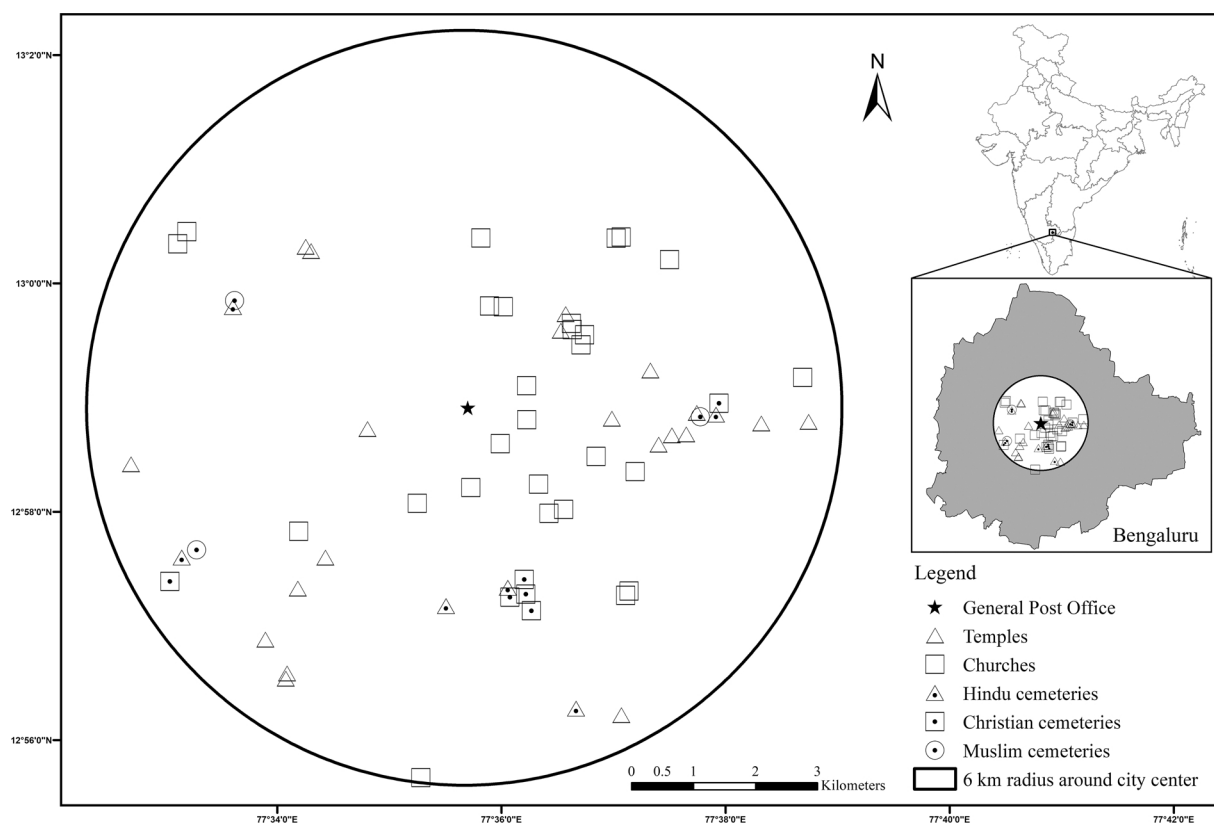


Fig. 1. Map of study area.

Ficus religiosa is primarily used in sacrificial fires and religious rituals (Nene, 2001). Planting of these *Ficus* species is also considered a divine act in ancient Hindu texts (Nalini, 1996; Krishna and Amirthalingam, 2014).

Sacred sites have been protected across the world by communities, and globally recognized as important sites for biodiversity conservation. Nature and culture are closely linked in these sacred spaces (UNESCO, 2005; Verschuuren et al., 2010). Despite the ecological and cultural significance of sacred sites in cities, there has been a substantial deficit in our understanding of the urban ecology of these spaces. Most literature on the biodiversity of sacred spaces focuses on rural areas, tending to ignore cities. Thus, recent research has called for increased attention to this important, yet neglected category of urban green spaces (Jackson and Ormsby, 2017). Cities in the Global South will be the main sites for spatial and demographic growth in the future, and India is no exception to this trend (UN-Habitat, 2016). Sacred spaces act as refuges for biodiversity, and have a potential yet relatively unexplored role to play in protecting urban biodiversity in the Indian context (Nagendra et al., 2013).

We aim to address the knowledge gap on the biodiversity and ecology of this neglected category of urban green space, through an examination of tree biodiversity in sacred green spaces in the south Indian city of Bengaluru, one of India's fastest growing megacities. We seek to document tree biodiversity, density, diversity and distribution across different categories of sacred green spaces, and to compare these to other types of land use in Bengaluru.

2. Study area

Bengaluru has a history of urban settlement dating back to the 16th century. The growth of the city has been shaped by its ecology and the interactions between humans and nature (Nagendra, 2016). From a largely open landscape, devoid of trees, Bengaluru was systematically greened over centuries by a succession of Indian and colonial rulers,

administrators, and citizens, gaining the reputation of the “Garden City” of India (Nagendra, 2016). Now one of the fastest growing Indian cities, owing to the information technology boom, Bengaluru has witnessed enormous changes to its environment including a progressive loss of green cover (Sudhira et al., 2007). Remnant patches of greenery exist in the core of the city in large heritage parks, educational and government institutions, and sacred spaces (Nagendra et al., 2012). Our research forms part of a larger study on the biodiversity of different kinds of green spaces in the city that include parks (Nagendra and Gopal, 2011), streets (Nagendra and Gopal, 2010; Vailshery et al., 2013), domestic gardens and apartment complexes (Jaganmohan et al., 2012, 2013), and informal settlements (Gopal and Nagendra, 2014; Gopal et al., 2015). Here, we extend this research to include sites of religious and cultural importance in Bengaluru that have been hitherto ignored, but constitute a very important part of urban biodiversity in Indian cities.

Many of the temples, churches and cemeteries in Bengaluru in this study have existed since historical times, constituting an important part of the cultural landscape of the city. The Someshwara temple in Ulsoor is believed to date to the Chola dynasty period, and was reconstructed by Kempe Gowda I, the founder of Bengaluru, in the 16th century. Some other temples, including Kadu Malleshwara, Dodda Ganapathy, Bull temple, and Kote Venkatramana temple also date back hundreds of years, providing glimpses of the interrelationship between the cultural landscape and ecology of the city. Thus, the Kadu Malleshwara (Kadu means forest in the local language, Kannada, while Malleshwara is the name of the temple deity) temple is named for the forested landscape in which it was once situated, while the Bull temple is believed to mark the origin of the Vrishabhavathi River (Annaswamy, 2003). Similarly, churches such as Trinity, Saint Mark's and All Saints Church founded under the Colonial rule in the 1800s (Rice, 1897), have become important cultural landmarks of the city, and contain large areas of relatively undisturbed urban green space within their boundaries that have been little studied.

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