RESEARCH ARTICLE

Genetic structure of the rattan *Calamus thwaitesii* in core, buffer and peripheral regions of three protected areas in central Western Ghats, India: do protected areas serve as refugia for genetic resources of economically important plants?

B. T. RAMESHA[1], G. RAVIKANTH[1,2], M. NAGESWARA RAO[1,3], K. N. GANESHAIAH[2,3,4] and R. UMA SHAANKER[1,2,4]*

[1]*Conservation Genetics Laboratory, Department of Crop Physiology, University of Agricultural Sciences, Bangalore 560 065, India*
[2]*Ashoka Trust for Research in Ecology and the Environment, Hebbal, Bangalore 560 024, India*
[3]*Department of Genetics and Plant Breeding, University of Agricultural Sciences, Bangalore 560 065, India*
[4]*Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur, Bangalore 560 064, India*

Abstract

Given the increasing anthropogenic pressures on forests, the various protected areas—national parks, sanctuaries, and biosphere reserves—serve as the last footholds for conserving biological diversity. However, because protected areas are often targeted for the conservation of selected species, particularly charismatic animals, concerns have been raised about their effectiveness in conserving nontarget taxa and their genetic resources. In this paper, we evaluate whether protected areas can serve as refugia for genetic resources of economically important plants that are threatened due to extraction pressures. We examine the population structure and genetic diversity of an economically important rattan, *Calamus thwaitesii*, in the core, buffer and peripheral regions of three protected areas in the central Western Ghats, southern India. Our results indicate that in all the three protected areas, the core and buffer regions maintain a better population structure, as well as higher genetic diversity, than the peripheral regions of the protected area. Thus, despite the escalating pressures of extraction, the protected areas are effective in conserving the genetic resources of rattan. These results underscore the importance of protected areas in conservation of nontarget species and emphasize the need to further strengthen the protected-area network to offer refugia for economically important plant species.

[Ramesha B. T., Ravikanth G., Nageswara Rao M., Ganeshaiah K. N. and Uma Shaanker R. 2007 Genetic structure of the rattan *Calamus thwaitesii* in core, buffer and peripheral regions of three protected areas in central Western Ghats, India: do protected areas serve as refugia for genetic resources of economically important plants? *J. Genet*. **86**, 9–18]

Introduction

Protected areas (PAs) are believed to be the cornerstones for biodiversity conservation, and the safest wilderness strongholds around the globe (Pimm and Lawton 1998; Bruner *et al*. 2001). In the face of ever-increasing threats to forests, the network of PAs offers the best possible approach to conserve biological diversity and the genetic resources of economically important species (Hogbin *et al*. 2000; Woodford 2000; Bruner *et al*. 2001; Theilade *et al*. 2001). For example, in Thailand, a large number of important timber species, which have been extensively harvested from the native forests, are now found only in PAs (Changtragoon 2001). Nevertheless, several concerns have been raised about the effectiveness of PAs in conservation. For example, PAs are often established based on the presence of large charismatic mammal species and, hence, might not address the conservation concerns of nontarget taxa (Rodgers and Panwar 1988). It has also been argued that PAs (a) are generally too small to

*For correspondence. E-mail: rus@vsnl.com.

Keywords. protected areas; genetic diversity; rattans; Western Ghats; conservation; *Calamus thwaitesii*.

host viable populations, (b) act as insular and isolated habitats that do not allow gene mixing across populations, and (c) can be costly and demanding in terms of logistics to secure from extraneous pressures and human encroachment (Chapman *et al*. 2003; Uma Shaanker *et al*. 2003).

In recent years, several attempts have been made to identify the gaps, if any, and determine the effectiveness of PAs in conserving biological diversity (Wickneshwari and Boyle 2000; Kutty and Kothari 2001; Nageswara Rao *et al*. 2001a; Uma Shaanker *et al*. 2003). Nageswara Rao *et al*. (2001b) showed that populations of sandal, a tree treasured for its heartwood oil in India and has been extensively poached, have higher genetic diversity in PAs such as national parks and sanctuaries than outside.

In this paper, we examine the effectiveness of PAs in conserving the genetic resources of a species of rattan (trailing or climbing palms) in the Western Ghats, a megadiversity centre in South India. Popularly also known as canes, rattans are used in the furniture industry and form an important component of the livelihood of forest-fringe communities in South and South-East Asia. A number of economically important species of rattans are extensively harvested, often leading to a severe lack of regeneration (Ravikanth *et al*. 2002; Narwade *et al*. 2003). We compared the population structure and genetic diversity of *Calamus thwaitesii*, an economically important cane, occurring in core, buffer and peripheral regions of three PAs in the central Western Ghats, India. The results show that PAs can play a significant role in conservation of nontarget species, particularly economically important species. Based on the results, we discuss the role of PAs in conserving the genetic resources of rattans in particular, and of other nontimber forest product species in general, and argue that PAs could form an important conservation approach for species that are highly threatened.

Materials and methods

Study sites and design

The study was conducted in the Western Ghats, India, one of the 25 biodiversity hotspots of the world (Myers *et al*. 2000). The PAs in the country comprise about 4.6% of the total geographical area (NWDC 1999). The Western Ghats includes 34 national parks and wildlife sanctuaries, together covering about 7300 km^2 (NWDC 1999). Based on the availability of rattan species within the PA network of the Western Ghats, three study sites, namely Anshi National Park (ANP; 14°54′ to 15°07′N latitude and 74°16′ to 74°30′E longitude), Kollur Mookambika Wildlife Sanctuary (KWS; 13°54′ to 13°38′N latitude and 74°38′ to 74°56′E longitude), and Sharavathi Wildlife Sanctuary (SWS; 13°54′ to 14°12′N latitude and 74°38′ to 75°00′E longitude) were selected for the study (figure 1). The two wildlife sanctuaries (Kollur Mookambika and Sharavathi) were established in the year 1974, and the Anshi National Park was established in 1987 (Kutty and Kothari 2001). However, much before it was declared as a protected area, ANP was part of the Dandeli Wildlife Sanctuary that was also established in the year 1974.

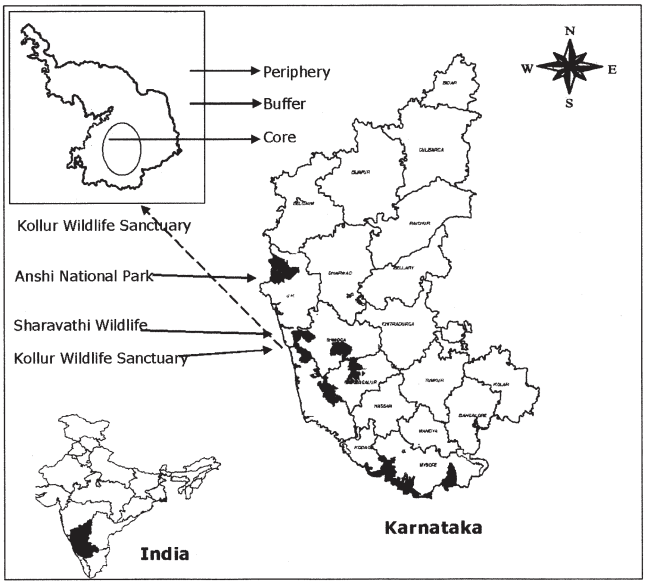

Figure 1. Map of the study sites at the central Western Ghats, India. The protected areas are all located in the central Western Ghats in the state of Karnataka (shaded). The arrows indicate the three protected areas studied.

Extraction of rattans has preceded the formation of the PAs and our own studies indicate that, in most parts of the Western Ghats, extraction of rattans has been recorded by the forest departments since the last 70 years (Uma Shaanker *et al*. 2004c). Harvesting of rattans is done each year. Based on the administrative boundary of each of the PAs, three zones, namely core, buffer and periphery, were identified, radiating outwards from the PA. Although PAs are supposed to be insulated from humans and cattle, often the peripheral and buffer regions tend to be more open to disturbance than the core of the PA because of the heavy pressures. Thus, the zones from core to periphery offer decreasing levels of protection against disturbance due to human interferences, cattle grazing, etc. As a measure of the extent of disturbance in each of the zones, the percentage of rattan stems harvested or cut was recorded (see details below). In each PA, the three zones were separated by approximately 2 to 3 km in a linear direction (core to buffer to periphery).

Study species

The study was carried out on an economically important species of rattan, *Calamus thwaitesii*, distributed in the Western Ghats (Lakshmana 1993; Ravikanth *et al*. 2002). This rattan is extensively used in the manufacture of furniture, umbrella handles, walking sticks, and sports goods, and forms the predominant rattan extracted from the Western Ghats (Lakshmana 1993; Renuka 1999; Ravikanth *et al*. 2001, 2002). The rattan is dioecious, and flowers between October and January, and fruits between April and May. Beetles and bees are the major pollinators of this species, whereas birds,