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Original Research Article

Assessment of the African baobab (*Adansonia digitata L.)* populations in Namibia: Implications for conservation

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ABSTRACT

This study assessed the population structure of baobabs (*Adansonia digitata)* in Kunene, Omusati, Otjozondjupa and Zambezi Regions in northern Namibia. Data were collected from 240 trees in randomly selected baobab clusters. The stem girth at breast height (gbh, converted to stem diameter), height and crown diameter were recorded for each individual tree. Any sign of damage on the stem was recorded. Average stem densities were determined and compared between regions. Stem number per diameter classes were presented in histograms. The highest baobab density (6.7 stems per ha) was observed in Omusati Region and the lowest (0.2 stems per ha) was observed in Otjozondjupa Region. A J-shaped stem diameter distribution was observed in Zambezi Region and an inverse J-shaped distribution in Kunene Region. Bell-shaped distributions were observed in Otjozondjupa and Omusati Regions. The percentage of damaged stems in the sampled populations showed more damaged than undamaged baobabs in Kunene (63%), Omusati (83%) and Otjozondjupa (95%), but in Zambezi there were fewer damaged (46%) stems. Elephant damage accounted for 41% of the damaged stems whereas human damage was 59%. Selective protection of large baobabs by communities may attribute to the high densities and occurrence of trees in larger size classes in comparison to juveniles. Overall, the baobab population is currently considered as stable in Namibia. However, factors that negatively affect recruitment and establishment of baobab need to be monitored to ensure that a higher proportion of young trees survive. The study recommends protection and propagation of baobab seedlings in order to maintain viable populations of the species. Sustainable harvesting practices of baobab bark is also recommended.

1. Introduction

It has been generally found, in a number of studies on baobab (*Adansonia digitata*) population structure and size classes, that there is a lack of young trees (Chirwa et al., 2006; Schumann et al., 2011; Mashapa et al., 2013; Venter and Witkowski, 2013; Munyebvu, 2015). This has led to the current study in Namibia to establish if the situation is the same, and if so, to devise conservation strategies. Furthermore, although we did not study the causes specifically, we elaborate on factors that may have an impact on the population structure.

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The stem size distribution of a population serves as an important determinant of population stability (Shen et al., 2013). A stable population shows a higher proportion of young individuals and the size class distribution reveals an inverse J-shaped distribution curve. Lower proportions of young individuals may be an indication of low recruitment or a declining population. However, long-lived species, like the baobab, may display a bell-shaped distribution, *i.e.* a higher proportion of trees in the middle size classes (Venter and Witkowski, 2010). The bell-shaped distribution could be a result of episodic recruitment and considered normal for baobab (Venter and Witkowski, 2010).

Desertification and land degradation are major threats to sustainable land use in Namibia (Pröpper et al., 2010). Moreover, agricultural expansion and livestock farming, which are major drivers of land change in Southern Africa, are also widespread in Namibia (Biggs et al., 2008; Kamwi et al., 2015). This may result in unsustainable population structures for non-timber forest product (NTFP) species, such as baobab that has multiple uses, because of such disturbances. Furthermore, international interest in NTFP's has resulted in an increase in the species that are being commercialized for their NTFP's in Namibia. The recorded number of species providing non-timber products for commercial uses has increased from one species (*Acanthosicyos horridus*) in 1990 (Erkkila and Siiskonen, 1992) to close to 10 species in 2014 (Cole, 2014). Examples of such species include *Sclerocarya birrea* (Marula), *Harpagophytum procumbens* (Devil's claw) and *Ximenia americana* (Blue sour plum). The current study will provide quantitative information of the baobab to understand the potential for this resource in Namibia.

The increase in human population growth has further increased pressure on exploited plant resources for subsistence use and resulted in a reduction of some species in Namibia. Some of these species have become locally extinct in commonage areas (owned by more than one person) and only available in adjacent protected areas (Kangombe, 2012). Lushetile (2009) observed the scarcity of *Bobgunnia madagascariensis,* a sought after medicinal plant in Zambezi Region (north-eastern Namibia). The species was not available in areas around Sachinga but abundant on the adjacent protected government farm. Rural communities selectively protect and conserve important indigenous tree species due to the contribution to their livelihood (Shackleton et al., 2015). However, such multipurpose species are faced with disturbances such as unsustainable harvesting practices, removal as development extends to pristine areas, herbivory or destruction by fire (Arnold and Perez, 1998; Alfaro et al., 2014; Ticktin, 2015). This warrants conservation efforts to maintain the population of important species such as the baobab.

Baobabs are distributed in the savannas of Africa where it functions as a keystone species (Whyte, 2001; Wickens and Lowe, 2008), and provides important non-timber forest products to rural communities (Assogbadjo et al., 2005; Diop et al., 2005; Chirwa et al., 2006; Buchmann et al., 2010; Venter and Witkowski, 2010; Cuni Sanchez et al., 2011; Schumann et al., 2011; Munthali et al., 2012; Munyebvu, 2015; Lisao et al., 2017). Every part of the baobab tree is believed to be useful to local communities as a food source, fiber, medicine or for spiritual welfare (Sidibe and Williams, 2002; De Caluwe et al., 2009; Kamatou et al., 2011). According to Lisao et al. (2017), the bark is the most important part of the baobab in Namibia. It is harvested by humans for fodder and medicinal purposes. Elephants (*Loxodonta africana)* also commonly strip the bark. This may potentially increase vulnerability of baobab trees to diseases and increase mortality rates of trees with smaller stem diameters (Wilson, 1988; Mudavanhu, 1998; Romero et al., 2001; Kassa et al., 2014).

Several studies have shown that the population structure of the baobab is influenced by land use and human activities through economic and socio-cultural uses of the tree (Wilson, 1988; Schumann et al., 2011). The baobab seems to thrive well in human settlements, crop fields and rocky outcrops in Mali while in other areas it is only in well protected areas or rocky outcrops, supposedly with little human disturbance (Assogbadjo et al., 2005; Duvall, 2007). In West Africa, there is a high population of baobabs in human dominated landscapes especially near homesteads (Duvall, 2007; Schumann et al., 2011).

The baobab is native to the Sudano-Zambesian drier areas that receive 200–800 mm of rain (Wickens, 1982). It is found in a range of habitats but Sidibe and Williams (2002) argue that its distribution is mainly restricted by a certain minimum annual rainfall. In Namibia, baobabs mainly occurs in the northern part of the country in *Colophospermum mopane* woodlands (Giess, 1998). Curtis and Mannheimer (2005) states that in Namibia, it is restricted to hot, dry woodland on stony, well-drained soils and in frost-free areas that receive low rainfall.

Baobab is currently listed as Least Concern (LC) according to the IUCN Red List Criteria (The IUCN Red List of Threatened Species, 2016). However, there are records of increased reduction in baobab populations across Africa (Leach et al., 2011). A study by Cuni Sanchez et al. (2010) predicted that there will be no areas in Namibia suitable for baobab growth in future due to effects of climate change caused by change in land use and global warming. In Namibia, the baobab is protected under the Forest Act No 2 of 2001 due to extensive uses by humans and animals (Government Republic of Namibia, 2015). However, the high demand for baobab products and associated changes in land use (exacerbated by human activities and climate change) are major factors that may threaten the occurrence of baobabs (Dhillion and Gustad, 2004; Venter and Witkowski, 2010; Schumann et al., 2011).

Despite the importance of the baobab to local communities in Namibia, data on the population structure of the species is limited (Lisao et al., 2017). There exists only one study on the population structure of baobab in Namibia (Munyebvu, 2015). The study was limited to Omusati Region where a bell-shaped distribution for the baobab population was observed. The aim of this study was therefore to describe the population structure of baobab populations in four selected areas in northern and north-eastern Namibia where the species occurs in relative abundance. The study assessed tree density and population structure (stem diameter class distribution) of baobab along a rainfall gradient, in order to develop site specific management guidelines for conservation interventions. It addresses the following study questions: Is the population structure of baobabs in Namibia stable? What conservation strategies will improve sustainability of the baobab population in Namibia?