

## The Dynamics on the Ecology of *Pterocarpus angolensis* DC

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### Research Article

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#### ABSTRACT

*Pterocarpus angolensis* is a tree species that is extensively used for its medicinal bark and good quality wood in South Africa. Its demand has resulted in some local extinctions in distribution area, leaving very few viable populations in natural areas. The current study was looked at the status of a pristine population located in the Lowveld National Botanical Garden, Mpumalanga Province, South Africa. Data on population parameters such as basal stem circumferences, plant height, and crown health estimates were collected from 16 transects of 100 m x 5 m. Results showed a healthy population that displayed an inverse J-shaped curve as analysed from some of the parameters sampled. More individuals found within the 0-50 cm stem circumference size class is an indication of a population with a healthy base for recruitment. Most of trees were in the 6.1-8.0 m height class which is a sign of a population with a good number of individuals in fruits bearing stage. High levels of canopy damage are an area of concern, since it impacts on the vigour of the population. It is concluded that this is a healthy population of *P. angolensis*, which could serve as a source of propagules in re-forestation programmes. It is recommended that the population be closely monitored for any signs of human disturbance, which would negatively influence its health.

#### INTRODUCTION

*Pterocarpus angolensis* DC is an angiosperm plant that belongs to the family Fabaceae, subfamily Faboideae. It is a deciduous tree, usually growing to 16 m in height, with dark brown bark and a high, wide-crowned canopy of shiny compound leaves. In favourable environment the trees are typically about 18–19 m tall. *Pterocarpus angolensis* is distributed within savanna woodlands and wooded grasslands of South Africa <sup>[1]</sup>.

In terms of its utilization the species provides high quality valued timber and other important non-timber benefits <sup>[2]</sup>. Its preference for timber is based on the fact that its brown heartwood is resistant to wood borers and termites, durable and has a pleasing spicy fragrance. The wood polishes well and is well-known in tropical Africa as *Mukwa* and is used to make good quality furniture that has an attractive light brownish-yellow colour. It can also be used for curios and implements. This wood also produces a rich, resonant sound and can be made into many different musical instruments. In Zimbabwe, the *mbira* (musical instrument which is also referred to as a thumb piano) board is traditionally made from this species <sup>[4]</sup>. Because of its high-value timber the species is exported from many countries in southern African region.

The non-timber benefits mainly include its traditional medicinal activities <sup>[3]</sup>. *Pterocarpus angolensis* is one of the most popular traditional medicinal plants in South Africa and is used for almost every conceivable ailment. It is used for treating various ailments such as ringworm, ulcers, and urinary schistosomiasis <sup>[4]</sup>. It has also been reported to treat eye problems, black water fever, stabbing pains, malaria, and increment of breast milk in breast feeding mothers <sup>[1]</sup>. The resemblance of the sap to blood has led to the belief in supposed magical healing powers concerning illnesses associated with blood.

Its intense collection due to its demand has brought *P. angolensis* populations to the verge of extinction. The viability of existing wild *P. angolensis* populations is threatened, not only due of extensive harvesting of its bark for medicinal purposes, or as fuel wood <sup>[5]</sup>, but also owing to establishment problems resulting from seedling failure after germination <sup>[6]</sup>. It has been estimated that only 2% of fruits produce seedlings in a given year <sup>[7]</sup>, with just half of those seedlings surviving the first year of growth <sup>[8]</sup>. Successful seed germination appears to depend on wild fires that remove the wings and bristles from pods, crack the seed and

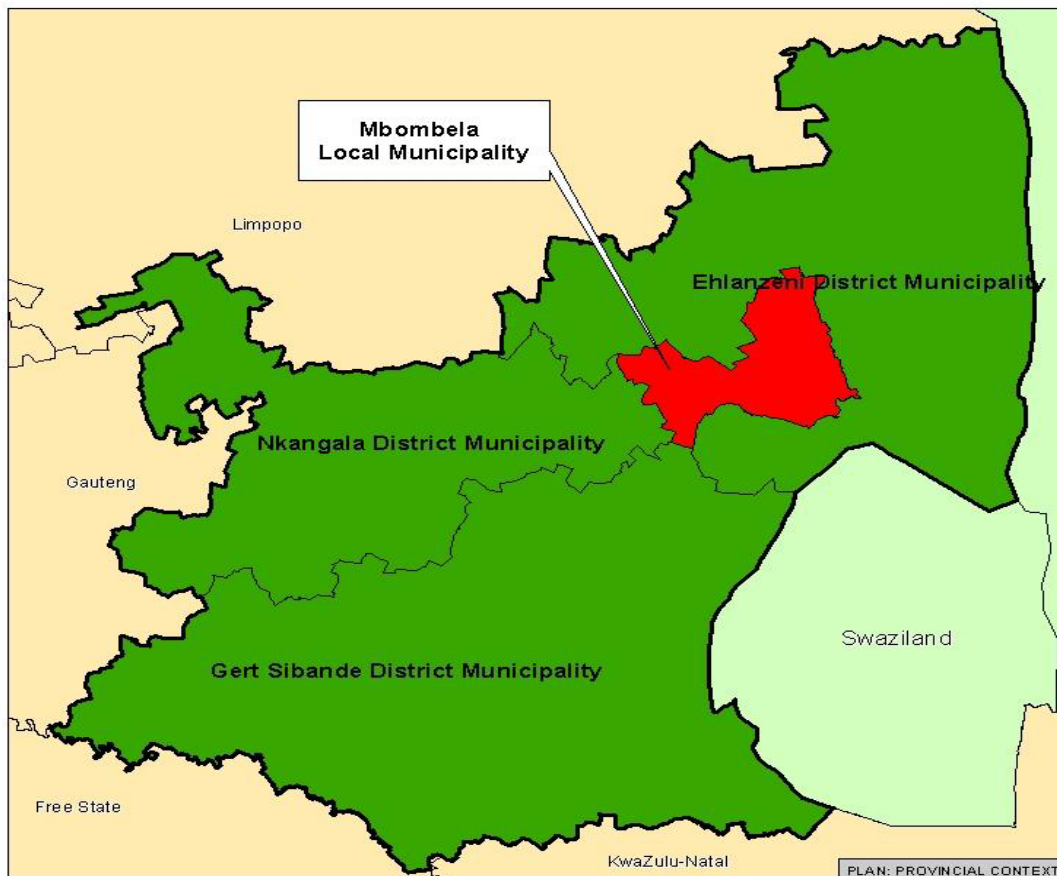
improve contact with the soil<sup>[9]</sup>.

The aim of this study was to analyse for the first time the status of an untouched *P. angolensis* population within a protected pristine area of the Lowveld National Botanical Garden (LNBG) in Mbombela (previously Nelspruit), Mpumalanga province of South Africa. This population needs to be continuously assessed and monitored as it could in the near future be an important propagule source for the re-introduction of *P. angolensis* into its native distribution area. The resultant loss of this population would have devastating consequences for the future of this species, as well as poor rural-based humans who depend on this species for their primary healthcare needs.

## METHODOLOGY

Data on population parameters of *P. angolensis* were collected at Lowveld National Botanical Garden (LNBG) in Mbombela, Mpumalanga province. Mbombela is a town within the Mbombela Local Municipality in north-eastern part of South Africa (**Figure 1**). The LNBG is 159 hectares, consisting of a 129 ha cultivated area and a 30 ha natural veld area. The natural vegetation in the LNBG is a savanna, which is an intermediate between Mixed Lowveld Bushveld and Sour Lowveld Bushveld. The LNBG is located between the latitude and longitudes of 25° 27'57"S 30° 59'07"E.

The LNBG features a humid subtropical climate with mild winters and warm summers. Summers are warm and somewhat humid, complete with precipitation, while winters are dry, with relatively warm temperatures during the day and chilly temperatures at night<sup>[10]</sup>.



**Figure 1.** Mbombela Local Municipality within the Mpumalanga province<sup>[11]</sup>.

The population structure was assessed by analysing the density, basal stem circumference (cm), plant height, and crown health estimates of 77 trees of *P. angolensis*. Sixteen transects of 100 m x 5 m were subjectively constructed within the population for sampling of all the individuals of *P. angolensis* located within them.

Basal stem circumference (cm) was measured with an aggregated measuring tape at the base of the stem. The circumference was placed in four size classes, namely: (A) 0-50 cm, (B) 51-100 cm, (C) 101-150 cm and (D) 151-200 cm. Plant height (m) was measured with an aggregated measuring pole, and placed in six classes, namely: (A) 0-2.0 m, (B) 2.1-4.0 m, (C) 4.1-6.0 m, (D) 6.1-8.0 m, (E) 8.1-10.0 m, and (F) 10.1-12.1 m. Crown health estimates were estimated using a 0-5 point sliding scale as follow: no crown (0), severe crown damage (1), moderate crown damage (2), light crown damage (3), traces of crown damage (4) and healthy crown (5). Accordingly, assessment of crown health using a 0-5 point sliding scale gives a good indication of tree overall health<sup>[12]</sup>.

Descriptive data analysis was done via MS-Excel software. The size-class distribution curve and regression analysis were also constructed through the same software.

## RESULTS AND DISCUSSION

### Density of *Pterocarpus angolensis*

The total area sampled from the 16 transects was calculated as follows:

$$\text{Area} = (100 \text{ m} \times 5 \text{ m} \times 16) = 8000 \text{ m}^2.$$

Therefore, density of trees was calculated as number of individuals sampled per total area sampled. The density calculation showed that there are 9.62 individuals per hectare. Although there is no optimum recommended spacing of individuals in a population, individuals that are well spaced perform best, while a dense population may experience density stress<sup>[13]</sup>. This population should therefore be safe from density stress. Individuals that are free from density stress perform better in terms of vigour and production of viable seeds.

### Population structure

More than a third of trees had a basal circumference, which fell in the 0-50 cm size class (**Table 1**). This indicates that the population has a healthy number of seedlings and young individuals, which will stand the population in good stead in the future, thus aiding in population sustainability. This is amplified by the fact that 59.74% of trees are mature and seed-bearing. The protection of the natural area from domestic animals plays a major role in minimizing overgrazing of the area. Seedlings are able to recruit with minimal disruption.

Similarly, the majority (33.77%) of trees were in the 6.1-8.0 m height class, which is a seed-bearing class. The production of fruits and seeds is further strengthened by the fact that more than 86.29% are mature individuals, all of which point to a sustainable future for this population. Disturbing is the fact that about 73% of trees had canopy damage (**Table 1**). Those that had no canopy damage fell nearly exclusively in the seedling/young tree category. The fact that 7% of individuals had severe crown damage is a point of concern. Crowns are damaged through defoliation which may be a result of fire or bark removal since their evidence was noted. However, in some cases insects and fungal infections were reported to cause large scale tree crown damage<sup>[14]</sup>. Difference in levels of defoliation can have different effects on the photosynthetic capacity of residual plant tissues<sup>[15]</sup>. Anthropogenic causes of defoliations can be identified and monitored in order to maintain healthy crowns.

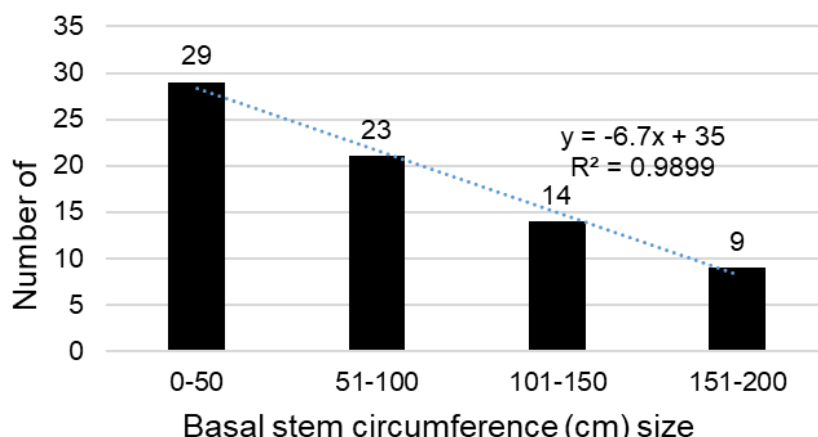
**Table 1.** Size classes of *P. angolensis* at the Lowveld National Botanical Garden.

Parameter	Size classes	Number of individuals (percentage)*
Basal stem circumference (cm)	0-50	29 (37.66%)
	51-100	23 (29.87%)
	101-150	14 (18.18%)
	151-200	9 (11.69%)
Height (m)	0-2.0	7 (9.09%)
	2.1-4.0	10 (12.99%)
	4.1-6.0	23 (29.87%)
	6.1-8.0	26 (33.77%)
	8.1-10.0	8 (19.39%)
	10.1-12.1	3 (3.89%)
Crown health estimates	0	8 (19.39%)
	1	6 (7.79%)
	2	12 (15.58%)
	3	10 (12.99%)
	4	20 (25.97%)
	5	21 (27.27%)

\*Percentages do not add up to 100, due to rounding off.

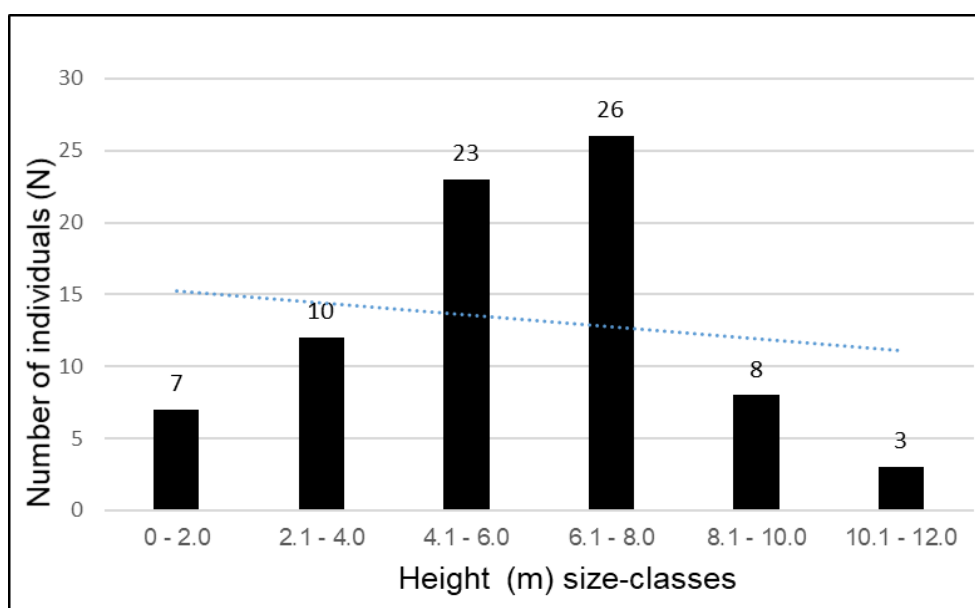
The population of *P. angolensis* as reflected on the size-class distribution graph resemble an inverse J-shaped curve (**Figure 2**). The inverse J-shaped curve indicates continuous recruitment of young stems. In a plant community level, it has been established that species richness is a dependent factor. The reason that the *P. angolensis* population sampled showed high numbers of individuals in the smaller classes indicate that it has the potential to increase the population in the future. The trend shown by an inverse J-shaped size class distribution indicates that there is a healthy and viable plant population<sup>[16]</sup>. The

abundance of seedlings indicates successful seed germination and a good establishment of *P. angolensis* seedlings.



**Figure 2.** Stem circumference size classes of *P. angolensis* at the Lowveld National Botanical Garden.

The linear regression on the natural logarithm of the density in the size classes against the size class midpoint produce a linear regression ( $r^2 = 0.9899$ ,  $Y = -6.7x + 35$ ). The slope and the Y-axis of this equation can be used to compare the population of *P. angolensis* in the future at the Lowveld National Botanical Garden.



**Figure 3.** Height size classes of *P. angolensis* at the Lowveld National Botanical Garden.

**Figure 3** indicates that seedlings are well recruited into the adult population, although few do remain in the lower size class. It therefore means that the majority of seedlings are able to quickly move from the lower height size classes. Seedlings of savanna tree species have been noted to have an ability to grow quickly once they have accumulated good starch reserve in their lignotubers as a way of escaping the fire zone<sup>[17]</sup>.

### CONCLUSIONS AND RECOMMENDATIONS

The use of size-class distribution provides a practical method of investigating the population dynamics of *P. angolensis* at the Lowveld National Botanical Garden. The data collected can be used in monitoring the changes in the population structure of *P. angolensis*. Management and control measures must be strengthened in order to conserve *P. angolensis* and maintain its good health status. The recommendation is that studies like this one should be implemented in communal areas where the community should get involved in observing the impacts of their unsustainable harvesting patterns on populations of indigenous plant species.

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