



Recruitment of *Pterocarpus angolensis* in the wild

T.M. Caro^{a,b,*}, M. Sungula^c, M.W. Schwartz^d, E.M. Bella^d

^a Department of Wildlife, Fish and Conservation Biology, University of California, 1 Shields Avenue, Davis, CA 95616, USA

^b Tanzania Wildlife Research Institute, P.O. Box 661, Arusha, Tanzania

^c P.O. Box 37, Mpanda, Tanzania

^d Environmental Science and Policy, University of California, Davis, CA 95616, USA

Received 11 March 2005; received in revised form 29 June 2005; accepted 1 July 2005

Abstract

Pterocarpus angolensis is a hardwood species subject to heavy exploitation throughout miombo woodlands of south-central Africa. Rates of natural recruitment measured in western Tanzania were found to be low, with only a third of parent trees generating any seedlings despite considerable seed production. Although heavily protected areas supported large parent trees, these adults had very few seedlings of >5 cm DBH nearby, possibly suggesting mortality caused by high densities of browsing ungulates. Outside these well protected areas, cutting has removed most large trees and remaining adults are small producing relatively few seeds. Factors affecting recruitment include location and elevation perhaps indicative of higher precipitation, whereas short grass and reduced parent canopy cover are associated with more seedlings suggesting competition for light. Given these recruitment rates, the prognosis for sustainable exploitation of *P. angolensis* looks bleak.

© 2005 Elsevier B.V. All rights reserved.

Keywords: Katavi ecosystem; Miombo; *Pterocarpus angolensis*; Tanzania

1. Introduction

Much of the vegetation in the central and southern part of the African continent is dominated by miombo woodland, a dry, deciduous forest characterized by *Brachystegia*, *Julbernardia* and *Isoberlinia* (Campbell, 1996; Rodgers, 1996; Burgess et al., 2004). Low human population density means that the relatively intact biome still constitutes one of the few great wilderness areas on the continent (Mittermeier et al., 2003). Despite this, a number of hardwood species are

heavily exploited commercially within the miombo nations of Angola, the Democratic Republic of Congo, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. Hardwoods are also harvested for export to Europe, Japan, and the Middle East. One of the principal hardwoods is *Pterocarpus angolensis* DC, used in construction, furniture and medicine. In Tanzania, the large quantities being removed from western, central and southern portions of the country raise the question of whether these logging practices are sustainable. A preliminary attempt to address this issue, based on proportion of felled adult trees of different sizes, indicated that rates of removal far exceeded recruitment into the adult population

* Corresponding author.

E-mail address: tmcaro@ucdavis.edu (T.M. Caro).

(Schwartz et al., 2002). Nonetheless, this study employed a matrix projection model that primarily used data on adult size distributions and extrapolation to inform assumptions regarding recruitment rates. If recruitment into the population is rapid, then the outcome of this model would be open to question.

An alternative way of producing *P. angolensis* is to grow it commercially for harvest. In an early attempt to determine the feasibility of this enterprise, Boaler (1966) conducted a comprehensive study of the ecology of the species but concluded that silvicultural problems occurred at all stages of development. These include difficulties in opening pods without damaging seeds, low rates of germination, annual dieback of seedlings, competition from other trees over sunlight, effects of fire, slow rates of tree growth, and delayed seed production. In practice, commercial attempts to grow *P. angolensis* have been largely unsuccessful (Van Daalen, 1991; Van der Reit et al., 1998).

In light of the greatly increased demand for *P. angolensis* in Tanzania since the time of Boaler's study, we decided to revisit some of his key findings on recruitment in this paper. Specifically, we wanted to confirm that estimations of recruitment were sufficiently low so as to preclude recovery of exploited populations in the wild or prevent profitable growth of nursery trees on a commercial scale.

2. Methods

Our study site is the Katavi ecosystem which lies in the Great Lakes Region of East Africa at the north end of the Rukwa Valley, north of Lake Rukwa in Mpanda District of Rukwa Region, Tanzania (Caro, 1999; Katavi-Rukwa Ecosystem Management Plan, 2002). The area is characterized by sandy soils and 611 mm of rainfall per year ($n = 27$ years) that falls between November and April. In August and September 2004 (late dry season), 300 adult *P. angolensis* were sampled in six different types of protected area: in Katavi National Park (NP) where no tree cutting has been allowed since 1912 when the area was first gazetted as a Game Reserve by German authorities; in Katavi National Park Extension (EXT) to the south-east where limited selective logging of trees was permitted in the wet season until 1998; in Lwafi District Game Reserve (GR) to the south west of the

NP where cutting is forbidden but is starting to occur illegally; in Mlele Game Controlled Area (GCA) to the east where cutting is sanctioned in the wet season; in Msanginia Forest Reserve (FR) to the north where cutting by business operations in Mpanda, the District capital, is permitted year round under license; and in Usevya Open Area (OA) to the south where logging by numerous entrepreneurs occurs throughout the year for local consumption (Fig. 1). In short, we sampled *Pterocarpus* across a gradient of cutting regimes.

In each type of protected area, we sampled 50 adult trees defined as having a DBH >25 cm; trees were selected if they had no other adult tree within 40 m although this was not always possible. At each tree we measured the DBH, number of recruits within a 10 m radius of the parent tree and again within a 20 m radius of the tree (these were subsequently combined in analyses); 20 m was chosen because Boaler (1966) had found that 92% of seeds fall within 10 m of the parent and few seeds were found beyond this distance. Size of all recruits was scored as follows: 0–0.5 m in height, 0.6–1.0, 1.1–1.5, 1.6–2.0, 2.1–2.5 m, and from then on the exact DBH of all larger recruits was measured. Most recruits were dormant at the time of sampling, during the dry season; seeds were present under most parent trees.

We measured several environmental variables at each parent tree (i) GPS location, (ii) altitude, (iii) whether the parent was less than 100 m from a standing water, (iv) soil texture (sand, silt, earth, rocks), (v) whether the area within 20 m of the parent tree had been burnt recently and/or trampled by ungulates, (vi) parent tree canopy size using a mean reading of a densitometer positioned on two sides of the parent tree trunk, and (vii) four measures of cover each on a six point scale: grass, herb, shrub and tree cover (see Caro, 2001). Data were analyzed using JMP 5.1 (SAS, 2000). We used a forward stepwise multiple regression procedure to assess whether combinations of variables were correlated with increased likelihood of seedling recruitment.

Finally, we recorded the relative numbers of standing and cut *P. angolensis* adult trees by driving a total of 232.5 km along minor roads in the six protected area types. These censuses were necessarily restricted to a 50 m bandwidth of visibility on either side of the road where cutting is relatively easy because of access yet endangers discovery by

Download English Version:

<https://daneshyari.com/en/article/9620103>

Download Persian Version:

<https://daneshyari.com/article/9620103>

[Daneshyari.com](https://daneshyari.com)