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Forest Ecology and Management 216 (2005) 149–165
Forest Ecology and Management
www.elsevier.com/locate/foreco

Subsistence harvesting of pole-size understorey species from Ongoye Forest Reserve, South Africa: Species preference, harvest intensity, and social correlates

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Received 12 October 2004; received in revised form 11 April 2005; accepted 10 May 2005

Abstract

We investigate the effect of subsistence harvesting on the ecological status of the pole-size tree component of the understorey at the Ongoye Forest Reserve (OFR; 2611 ha), KwaZulu-Natal province, South Africa. Using generalised linear modelling (GLM) we examine the ecological and social correlates of species preference and harvest intensity. Data were collected from 22 strip transects (5 m × 300 m; 0.15 ha). Only 11.6% of the available pole-size trees (2 cm < DBH < 15 cm) were harvested, mostly for building materials. No instance of canopy tree logging was recorded. Sixty-eight species were identified; however, only seven species (82% of harvested stems) were preferred: *Englerophytum natalense* (33%), *Garcinia gerrardii* (19%), *Drypetes gerrardii* (9%), *Tabernaemontana ventricosa* (9%), *Rinorea angustifolia* (4%), *Oxyanthus speciosus* (4%), and *Chrysophyllum viridifolium* (4%). Size-class distributions for these seven species were inverse J-shaped, typical of fine-grained species that regenerate over small spatial scales, suggesting that current harvesting intensities may be sustainable. Pole-size stem density was significantly similar among residual stands in harvested areas (2014 ± 31 stems ha^{-1}) suggestive of a stem-density harvest threshold below which further effort was unprofitable. The number of harvested stems increased with increasing stem availability across species and stem size-classes. Small size-classes (2–5 cm DBH) were harvested most intensely, followed by the intermediate (5–10 cm) and the large (10–15 cm) size-classes, for all species except *C. viridifolium*. For the latter, the harvesting intensity was greatest for the 10–15 cm size-class. Lastly, harvest intensity was greatest in those areas closest to households near the reserve boundary but was not affected by household density. Although subsistence harvesting at the OFR appears to be sustainable at current levels, we note that similar harvest intensities of pole-sized stems in studies from smaller forests (<60 ha) led to local extinction of tree species. In addition, because the dominant understorey species at OFR are almost exclusively harvested, the mid- to long-term effects of this harvesting preference on forest dynamics must be assessed to develop sound ecological forest management policies.

Keywords: Harvest intensity model; Poles; Species preference; Subsistence harvesting; Sustainable use; Subtropical forest; Understorey species

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doi:10.1016/j.foreco.2005.05.029

1. Introduction

Modern forest management systems are focussed on balancing the needs (rate of resource use) of users against the regeneration ecology and growth of the resource base to ensure the sustainable use and conservation of forest resources (McGregor, 1994; Hartshorn, 1995). Understanding the effects of harvesting on the composition and structure of the residual stand is essential for developing optimum harvesting systems (Cannon et al., 1994). Optimum management systems should only marginally alter the natural demography and biomass of the standing crop, and harvest levels should not exceed rates of resource regeneration or severely depress recruitment potential (Lawes et al., 2004). However, in most African forests subsistence harvesting is not effectively managed (Oates, 1999) and typically unsustainable harvesting rates are defined by various factors, such as short-term needs of consumers, power of traditional and formal authorities, size of consumer community, availability of suitable tree stem sizes, and forest size and accessibility (Burgess et al., 2000). In this study we examine the rates of harvesting of pole-sized timber and the important social and ecological correlates of subsistence harvesting intensity in Ongoye Forest Reserve (OFR), KwaZulu-Natal province, South Africa.

In Africa, formal tree species selection and harvest strategies have to date focussed on large-scale and/or large-tree logging processes (West and Central Africa: Poorter et al., 1996; Struhsaker, 1997; South Africa: mortality-preemption methods; Seydack, 1995, 2000; Seydack et al., 1995). These strategies arise from, and are designed to meet, the demand for commercial timber. However, they overlook the intensive use and potentially insidious ecological effects of intensive subsistence harvesting of pole-size trees (Hall and Rodgers, 1986; Peden et al., 1996; Vermeulen, 1996; Vermeulen et al., 1996; Semesi, 1998; Ham and Theron, 1999; Burgess et al., 2000; Obiri et al., 2002). For example, Obiri et al. (2002) demonstrated that mostly pole-sized stems were harvested by subsistence users and furthermore, that a harvesting intensity of 10% of pole-size trees from relatively small forest patches in South Africa resulted in the local extinction of some understorey species. Of concern is that harvesting intensities as high as 50% of the available pole-size trees are common from easily accessible forests in Africa (Hall and Rodgers, 1986; Burgess et al., 2000). Of further concern is that harvested pole-size trees are sometimes immature canopy trees, but are most frequently unreproductive individuals from understorey species. There is the potential for this selective harvesting of understorey species to affect forest tree dynamics, either causing deviation from the normal successional pathway for trees or arresting succession (Chapman et al., 1999) and changing tree species composition (Burgess et al., 2000).

To date the ecology of understorey tree species has received little attention because these small trees are perceived to be abundant and of limited commercial value (Newbery et al., 1999). Indeed, in large forests that were exploited for their timber, a common silvicultural practice was to remove "useless" understorey species (Nicholson, 1965). Pole-size trees of understorey species may be important in the maintenance of forest dynamics and tree diversity (Newbery et al., 1999; Lawes and Obiri, 2003). The ecology of understorey species should be receiving greater attention, given that these stems are most targeted by subsistence harvesters in developing countries where the harvesting pressure on forests is greatest.

Clearly, suitable tree species selection and harvest strategies that are based on the ecology of the pole-size class need to be developed (Lawes and Obiri, 2003). In this study at OFR we evaluate the level of use of pole-size trees (species, size-class, harvested stems ha^{-1}) by local harvesters, as well as resource availability (the size of the residual stand). We identify the ecological (stand density and species richness) and the social (household distance and density) correlates of pole-size tree harvesting, and in so doing, develop a foundation for the management of the harvest of understorey tree species in a sub-tropical forest.

2. Methods

2.1. Study site

The Ongoye Forest Reserve (28°50′S, 31°42′E; 3900 ha), created in 1914, is located on the Ongoye range of hills (altitude: 305–490 m), which are 12 km from the coast. The reserve comprises a species-rich