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Research Application Summary

Gap size in regeneration of red stinkwood in natural forests in Kenya

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Abstract

Red stinkwood (*Prunus africana*) is widely known for its medicinal value, both locally in Kenya and globally. The survival of the species depends on among other things, forest regeneration gap sizes created by humans or natural phenomena. The objective of this review was to analyse existing knowledge, with a view to identifying appropriate gap size for regeneration of *P. africana* in natural forests. It is apparent that large gap sizes tend to suit the growth of pioneer species, which compete with *P. africana* seedlings for resources, especially sunlight. On the other hand, closed canopies stifle seedlings, owing to excessive litter accumulation and shading, thus limiting light penetration to forest floors. Its saplings are shade intolerant, thus need intermediate gap size to survive. Poor natural regeneration, coupled with over-exploitation of *P. africana* have adversely affected the population of the species in Kenya. Because of this, collaborative management has been adopted to incooperate local communities, as well as a ban on its bark exportation for its conservation.

Key words: Kenya, Light penetration, *Prunus africana*, saplings

Résumé

Le Prunier d'Afrique (*Prunus africana*) est largement connu pour sa valeur médicinale, à la fois localement au Kenya et dans le monde. La survie de l'espèce dépend, entre autres, de la taille des trous de régénération forestière créés par l'homme ou des phénomènes naturels. L'objectif de cette revue était d'analyser les connaissances existantes, en vue d'identifier la taille appropriée des écarts pour la régénération de P. africana dans les forêts naturelles. Il est évident que les grandes tailles d'écart ont tendance à convenir à la croissance des espèces pionnières, qui rivalisent avec les semis de P. africana pour les ressources, en particulier la lumière du soleil. D'autre part, les canopées fermées étouffent les semis, en raison de l'accumulation excessive de litière et de l'ombrage, limitant ainsi la pénétration de la lumière dans les sols forestiers. Ses jeunes arbres sont intolérants à l'ombre et ont donc besoin d'une taille d'écart intermédiaire pour survivre. Une mauvaise régénération naturelle, associée à une surexploitation de P. africana, a eu des effets négatifs sur la population de l'espèce au Kenya. De ce fait, une gestion collaborative a été adoptée pour faire coopérer les communautés locales, ainsi qu'une interdiction d'exporter son écorce pour sa conservation.

Mots clés : Kenya, Pénétration de la lumière, *Prunus africana*, jeunes arbres

Introduction

Red Stinkwood (*Prunus africana*) is a tree species endemic to Africa, where it is faced with rising demand accruing from its medicinal value. Consequently, it has been included in the Red List and in Appendix II of CITES (Nguta, 2012). The annual export of *P. africana* bark from Africa rose from 3,200 to 4,900 metric tonnes in the year 1998, and was projected to surge even more from 7000 to 11,000 metric tonnes by 2018 (Cheboiwo and Langa, 2014). In Kenya, the average export of *P. africana* bark ranged between 200 and 250 metric tonnes during 1995-2003 (Cunningham *et al*., 2016).

Several studies have been done on the influence of gaps on regeneration of the tree species (Koros *et al*., 2016; Ronoh *et al*., 2018); however, there is paucity of information on regeneration of *P. africana* in relation tovarious gap sizesin forest.Thus, the objective of this review was to analyse existing knowledge with a view of supporting designers of appropriate gap size for regeneration of *P. africana* in its natural forest environment.

Natural regeneration of woody species in forests. In natural forests, seed regeneration is determined by the proximity to the mother plant, that is, a lot of seedlings are expected under or near the mother trees in any forest (Lohbeck *et al*., 2020). Regeneration can arise from soil seedbanks, seed rain, seed dispersal or coppicing (Franklin *et al*.,1987).

Regeneration plays an integral role in silvicultural management systems within forests. It allows for restoration of degraded forests; however, variations exist in natural regeneration patterns caused by differences in tree speciesrequirements and types of management (Hammond *et al*., 2020). *Prunus africana* is, therefore, neither shade tolerant nor shade intolerant (Gladys, 2020); hence, its regeneration and development are not assured in closed canopies. The seedlings may be dense under the mother plant, but might not develop into sapling and pole stage due to shading (Koros*et al*., 2016). Its regeneration and development patterns should be closely observed to conserve it in its natural habitat. This implies that the species needs moderate gap sizes at sapling stage in order to transits into poles (Jimu *et al*., 2012).

Forest gap sizes and regeneration. Gaps are holes in forest canopies created by disturbances (biotic or abiotic),which results from death or removal of tree species in a forest (Lutz and Halpern, 2006). Gaps play a critical role in the turnover of species composition, structure and nutrient flow (Lutz and Halpern, 2006). However, increased levels of disturbances cause tree mortality and may threaten the stability of the forest (Wang *et al*., 2012).

In Kenya, forest gap sizes have received limited research and development attention, in spite of their critical importance in forest establishment. Over-exploitation of certain endangered tree species, such as P. africana,has become a major issue in biodiversity conservation (Ronoh *et al*., 2018).*Prunus africana* is an indigenous species to Africa, but has been disturbed by human activities, including variation in forest gap sizes (Koros *et al*., 2016).

Selective logging of the species causes poor regeneration of the species since the mature reproductive trees are often the major targets (Ronoh *et al*., 2018). Poor natural regeneration of *P. africana* has also been attributed to unfavourable conditions of insufficient light penetration

to the floor from the mature canopy (Gladys, 2020), and thick litters characterised by reduced decomposition; a condition that facilitates rotting of *P. africana* seed (Myers *et al*., 2000).

In Kenya, studies on *P. africana* regeneration in relation to forest gap sizes have not been topical in research for development; however, the species has been found to regenerate well under small light gaps beneath mother plants but few transits to saplings due to shading (Koros *et al*., 2016). It has also been found to regenerate less or not at all is places with constant disturbances such as grazing and forest fires (Ronoh *et al*., 2018). This has been attributed to its increased population reduction, which has made it extinct in some parts of Kenya (Koros *et al*., 2016). Kenya has, therefore, banned exploitation of the species and introduced permits for its extraction. Communities have also been incooperated in its conservation; whereby farmers are beginning to domesticate it as well as reporting illegal extraction (Hall *et al*., 2000).

Conclusions

Forest gaps influence the availability of resources (e.g.,sunlight, temperature andmoisture) which in turn determine colonisation of tree speciesdepending on the gap size. Different tree species responds differently to gap sizes based on their functional traits and levels. *Prunus africana* is a delicate tree species under the threat of extinction in Kenya due to its poor regeneration. The species is neither favoured by large gap sizes nor small gap sizes, but can do well in intermediate gap sizes. Therefore, intermediate gap size can be used to conserve the species in-situ.

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