Research Application Summary

Regeneration dynamics of woody species in degraded natural forests in western Kenya

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Abstract

Deforestation has become rampant in many areas in Kenya due to pressure on land resulting from human population increase. Efforts to rehabilitate areas that have been deforested have had little success due to the limited knowledge of vegetation community dynamics during regeneration. In this study, we evaluated the effect of repeated site disturbance, habitat quality seed dispersal limitation on woody species regeneration. Study sites were protected or left unprotected in Kibiri, Wire and Homa hills and monitored for 2 - 3 years. The effect of protection was significant for number of stems/ha and rate of height increase. No seeds germinated in the green house from soils collected from study areas. From this study, decision support tools for forest managers will be developed.

Key words: Biodiversity, forest rehabilitation, forest regeneration, habitat quality succession

Résumé

Le déboisement est devenu galopant dans beaucoup de régions au Kenya dû à la pression sur l'acquisition de terre résultant de la pression démographique. Les efforts de réhabilitation des régions qui ont été déboisées, ont eu peu de succès à cause de la connaissance limitée de la dynamique communautaire de la végétation pendant la régénération. Dans cette étude, nous avons évalué l'effet de la perturbation répétée du site, la limitation de dispersion de graine de qualité d'habitat sur la régénération d'espèces de bois. Les milieux d'étude ont été protégés ou laissés non protégés dans les collines de Kibiri, de Wire et de Homa et ont été surveillés pendant 2 ou 3 ans. L'effet de la protection était significatif pour le nombre de tiges/ha et le taux d'augmentation de la taille. Aucune graine n'a germé dans la serre à partir des sols retenus des milieux d'étude. De cette étude, des outils de support de décision pour les gestionnaires de forêt seront développés.

Mots clés : Biodiversité, réhabilitation de forêt, régénération de forêt, succession de qualité de l'habitat

Background

Natural forests provide essential environmental, economic and socio-cultural benefits in Kenya (Ministry of Environment and Natural Resource, 2005). They are important for the conservation of biodiversity, livelihood support and climate change mitigation (ODA, 1991). However, despite their crucial functions and fragile nature, these forests have become the epicentres of human – forest conflicts over the past 2 decades, as a result of land use systems that are destructive to their ecological stability (Blanc *et al.,* 2000).

Literature Summary

Attempts to rehabilitate these forests have had little success, because of poor understanding of vegetation community dynamics during early stages of forest regeneration (Duncan and Chapman, 2003; Sajise, 2003). Non-wood plants such as ferns, grasses and shrubs often invade degraded natural forest habitats at the expense of woody species, which may take decades to recruit (Hermy *et al.,* 1999; Verheyen *et al.*, 2003). The traditional view of secondary forest succession (Clements, 1916) suggests that the low re-colonizing capacity of woody species may be due to poor habitat quality caused by deforestation. Other studies have suggested that habitat quality may not be the main factor regulating woody species regeneration in a degraded forest (Verheyen and Hermy, 2001). This study sought to evaluate the effect of repeated site disturbance, habitat quality and seed dispersal limitations on delayed woody species regeneration 2 decades after forest degradation in both moist and sub-humid natural forests in western Kenya. Findings of the study are expected to serve as decision support tools for forest managers in designing strategies to accelerate the natural recovery of degraded indigenous forests in Kenya.

Study Description

The study was carried out in Kibiri, Wire and Homa hills. This study employed a randomized complete block design with 4 replicates. Each sample plot measured 80 m by 40 m. One half of the sample plot was protected from grazing, trampling and other forms of disturbance using an enclosure. The other half was exposed to disturbance and served as a control. Parameters (plant life-form, canopy stratification, species names, abundance, diversity or diameter at breast height (dbh) / root collar diameter (rcd) for tree seedlings) were assessed at intervals of 12 months for a period of between 2 and 3 years. Assessment was carried out to evaluate the possibility of seed failing to reach any or parts of the degraded sites because of site isolation in terms of distance (Verheyen and Hermy, 2001; Verheyen *et al*., 2003a).

Baseline data were captured from all sample plots to describe site conditions at the beginning of the study using parameters such as soil texture, moisture level, pH and litter layer.

Research Application

There was a significant increase ($P < 0.05$) in the stand population density (number of stems ha^{-1}) in the areas protected from disturbance in Kibiri, Wire and Homa hills. Undisturbed sites in the moist forest attained a normal distribution curve (an inverse-J shaped curve) (Tabe 1) in 2 years, while the two sub-humid forests had not attained a definite dbh distribution pattern by the third year. Undisturbed sites within the moist forest had a higher rate of height increase than the sub-humid forests. In Kibiri, natural regeneration was faster in sample plots with more remnant trees (Table 2). There was no germination from the soil seed bank in the greenhouse for all soil samples collected over a period of 2 years.

Table 1. Relationships between stand population density following site protection in Kibiri, Wire and Homa hills with time.

Forest	Relationship	R^2
Kibiri	Y = 315.9 ln(x) - 35.012	0.7297
Wire	Y = 129.26 ln(x) + 56.5	0.4816
Homa	Y = 37.9 ln(x) + 53.06	0.5309

Table 2. Effect of remnant trees on natural regeneration (species diversity in brackets).

Sample plot	No. of remnant trees within the plot	Regeneration status (no. of stem ha^{-1})		
		Year 0	Year 1	Year 2
Kibiri 1	3 (3)	2 (2)	5 (3)	9 (4)
Kibiri 2	19 (8)	10 (5)	62 (10)	391 (26)
Kibiri 3	14 (6)	8 (4)	51 (8)	283 (21)
Kibiri 4	7 (4)	4 (2)	13 (5)	97 (13)

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