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The association between rainforest disturbance and recovery, tree community composition, and community traits in the Yangambi area in the Democratic Republic of the Congo

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Research Article

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Abstract

Despite their key role in biodiversity conservation, forests in the Congo Basin are increasingly threatened by human activities, but it remains challenging to assess the impact of forest degradation under a more or less intact canopy. Likewise, forest recovery following agricultural abandonment remains poorly understood in the Congo Basin. Here, we surveyed 125 vegetation quadrats across 25 forest inventory plots in the Yangambi area. We aimed to find associations between both selective logging and forest recovery, and a range of forest community and tree community trait characteristics, as compared to reference undisturbed old-growth forest. We found that plots in undisturbed old-growth forest harboured both more tree individuals and tree species with a higher wood density as compared to plots in disturbed old-growth forest. In addition, their tree community composition was significantly different, whereas species diversity recovered since relatively recent agricultural abandonment (< 60 years), community composition and forest structure remained significantly different from the plots in undisturbed old-growth forest. Our study provides some insights into the rate of forest recovery in the Congo basin after agricultural abandonment and highlights the need of proper conservation of the remaining relatively undisturbed old-growth forests. Finally, we stress the need for more extensive vegetation surveys in the Congo Basin to further unravel the effects of anthropogenic disturbance.

Introduction

The African continent is home to the world's second largest area of tropical forests which are, together with earth's subtropical forests, by far the most floral-rich biomes on earth (Kier *et al.* 2005, Malhi *et al.* 2013). The African tropical forests appear to be less biodiverse than their Asian and American counterparts (Kier *et al.* 2005, Parmentier *et al.* 2007, Slik *et al.* 2015). Nevertheless, Sosef *et al.* (2017) recorded 22,577 plant species in tropical African forests, of which 30% are endemic, and concluded that much botanical exploration still remains to be done. The forests of the Congo Basin, which account for 89% of the African tropical forests, are also extremely important as carbon sinks, removing up to six times more carbon than the forests in the Amazon region (Harris *et al.* 2021, Malhi *et al.* 2013). Furthermore, the African carbon sink has been stable for the past three decades until 2015, while the Amazonian carbon sink has been declining since the 1990s (Hubau *et al.* 2020).

Despite their key role in biodiversity conservation and carbon sequestration, forests in tropical Africa are increasingly threatened by human activities (Tyukavina *et al.* 2018). Between 1990 and 2000, the annual net loss of forests in Africa corresponded to 3.3 million ha yr^{-1}, increasing to 3.4 million ha yr^{-1} between 2000 and 2010, and further to 3.9 million ha yr^{-1} between 2010 and 2020 (FAO & UNEP 2020). Africa is currently the only region where annual forest change rates are still increasing (FAO & UNEP 2020). The deforestation on the African continent is mainly caused by small-scale subsistence agriculture (Curtis *et al.* 2018, Jayathilake *et al.* 2021, Tegegne *et al.* 2016, Tyukavina *et al.* 2018), driven by very low agricultural yields (Carrasco *et al.* 2017, West *et al.* 2010), and a rapidly growing human population (Gerland *et al.* 2014).

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