

EARTH OBSERVATIONS OF FOREST DYNAMICS AND CARBON CHANGE IN SMALL CENTERS OF ENDEMISM: A CASE STUDY FROM THE ANGOLAN SCARP FORESTS

ANA LEITE^{1,*}, Aimy Cáceres^{1,2}, Martim Melo^{1,2,3}, Michael Mills^{3,4}, and António T. Monteiro¹

¹ Centro de Investigação em Biodiversidade e Recursos Genéticos, CIBIO-InBIO Laboratório Associado, Universidade do Porto, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal.
² ISCED – Instituto Superior de Ciências da Educação da Huíla. Rua Sarmento Rodrigues s/n, CP 230. Lubango, Angola.
³ DST/NRF Centre of Excellence at the Percy FitzPatrick Institute, University of Cape Town, Rondebosch 7701, South Africa.
⁴ A. P. Leventis Ornithological Research Institute, University of Jos, PO Box 13404, Jos, Plateau State, Nigeria.

*anacatarinamleite@gmail.com

BACKGROUND

Tropical deforestation contributed significantly to human-induced CO₂ emissions [1] and thus, curbing deforestation is crucial for reducing carbon emissions. The important role of forests to mitigate climate change was recognised globally under several emissions reduction programmes (Reducing Emissions from Deforestation and Degradation - REDD+), particularly in large remaining forest areas with high deforestation rates. Consequently, small areas that provide refuges for endemic biodiversity of global conservation significance are easily overlooked. Although such regions hold a small proportion of the world’s terrestrial carbon stocks, they can make an important contribution to emission reductions, as they often hold carbon-rich forests [2].

OBJECTIVES

KUMBIRA is located in the western Angolan province of Cuanza Sul. Although small and poorly documented, is one of the **Central Angolan Scarp Forests** that holds more populations of endemic bird species and botanical diversity. Recently, a new primate species was discovered in Kumbira Forest and considered already endangered [3]. This unique habitat is under severe threat from overexploitation of their forest resources. In this study, using satellite imagery analysis and in-field survey, we pattern deforestation and aboveground carbon stocks by specifically addressing:

- FOREST COVER CHANGE and DEFORESTATION rates between 1991 and 2014;
- SPATIAL FACTORS governing forest loss;
- ABOVEGROUND CARBON STOCKS and CARBON EMISSIONS from deforestation.

The implications of our findings in the small centre of endemism of Kumbira under the REDD+ mechanism was further explored.



HIGHLIGHTS



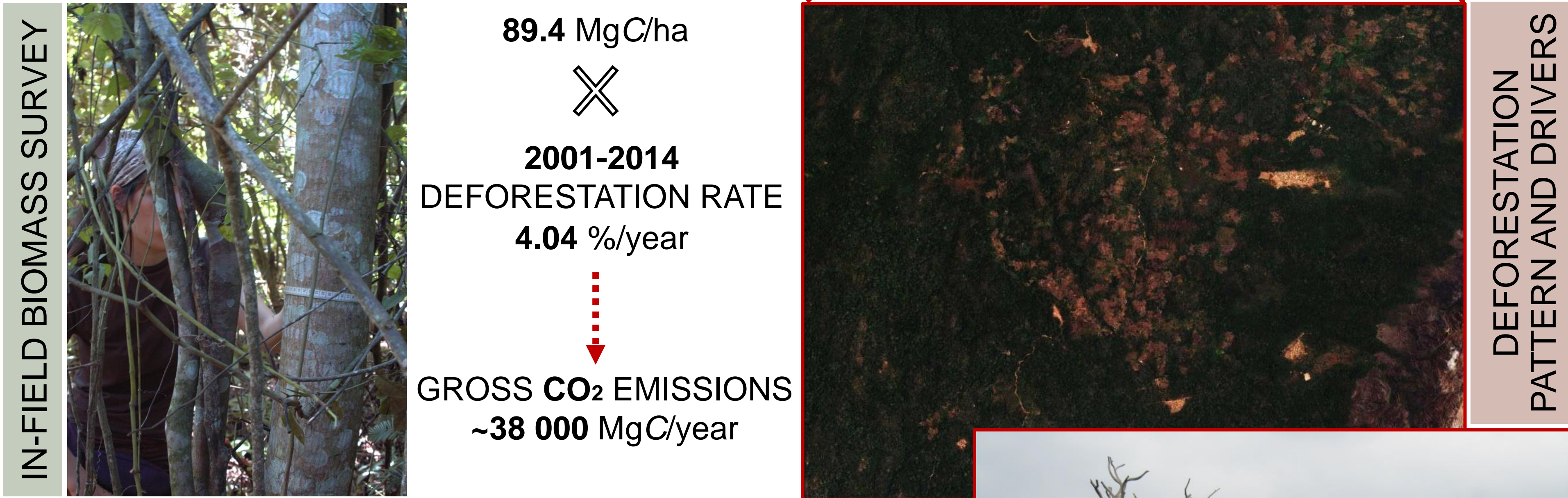
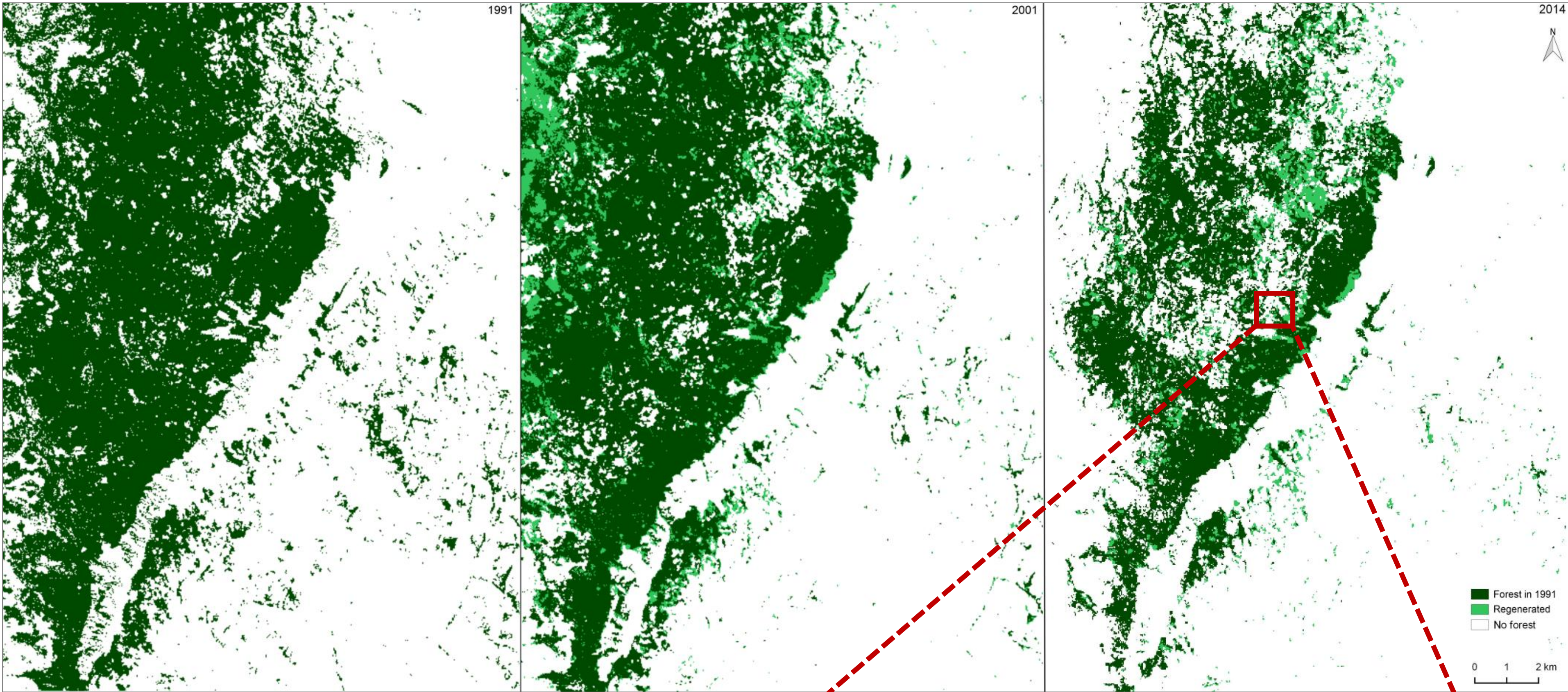
Forest cover decrease occurred mostly after the end of the civil conflict (a remarkable 41% **loss of forest cover** at Kumbira, contributing with ~ 500000 MgC to the atmosphere, in only 14 years - from 2001 to 2014 - has been found), while during the last decade of the war (1991-2001) no significant changes in forest cover were detected. This pattern is related to the population exodus from rural regions during the 27 years of **civil conflict** in Angola and their return to forests after the end of the war in 2002. Overall, the changes in forest cover at Kumbira Forest reflect the effects of increasing **human demographic pressure** after the end of civil conflict in this region. In addition, based in our field campaign and the expansion of the **road network** we argue that deforestation at Kumbira shows no signs of slowing down as increasing in **illegal logging** and **slash-and-burn agriculture** persists.



International mechanisms to reduce deforestation and emissions, including **REDD+** or others Payments for Ecosystem Services, programmes may have an important role in small centres of endemism as Kumbira and the remaining forests of the Angolan Scarp. Here, valuable **carbon stocks** (average aboveground carbon is only slightly below the range - 118-202 Mg ha⁻¹ - found in recent studies from REDD+ target countries in Central Africa [4]) overlap small, threatened, biologically-rich forests easily overlooked by large-scale REDD+ models. The allocation of international funds should prioritize the delimitation and management of a **protected area** to conserve the remaining old-growth forest and provide incentives for the **sustainable use** in surrounding landscape. Regeneration of **shade coffee plantations** seems a feasible alternative to traditional land use schemes. After independence, most of the coffee plantations settled by the Portuguese farmers were abandoned. Canopy cover and tree diversity on shaded coffee farms contributes to **increase carbon storage** and has repeatedly been shown to be **beneficial for biodiversity** [5].

FOREST CHANGE AND EMISSIONS CARBON FACTORS ASSESSMENT

Landsat scenes from **1991, 2001 and 2014** were used to assess forest cover dynamics in the study area. To map forest, a **supervised classification** with **maximum likelihood algorithm** was implemented. Lastly, **generalized linear models** were preformed to identify factors governing forest loss.



The AIC model selection indicated that the model that better explain forest loss in Kumbira during 2001-2014 is a combination of **topography** (“slope”, “elevation”, “cosine” and “sine aspect”) and **distance** variables (“distance to trails” and “distance to streams”). The best single predictor is “**distance to trails**” with a odds ratio of **0.803**. Pseudo-R² = **0.278**; AUC/ROC = **0.78**.



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