Conservation Planning and Viability in the Selous-Niassa Trans Frontier Conservation Area, Southern Tanzania: A safe corridor for people and Wildlife

Hamza K Kija[1]*, Sarah Mokheha[2], Mohamed Kamuna[3], Emanuel Kivuyo[4], Richard Katondo[4], Julian Easton[4], Maria Montero Botey[5], and Fortunata Msoffe[6],

[1]*Tanzania Wildlife Research Institute (TAWIR), P. O. Box 661 Arusha, Tanzania,* [2]*Ruvuma Region Secretariat, P.O.Box 74, Songea, Tanzania,* [3]*Community Wildlife Management Areas Consortium, P.O. Box 13685, Dar es Salaam, Tanzania,* [4]*World wide Fund for Nature, Dar es Salaam, Tanzania* [5]*Universidad Politécnica de Madrid and* [6]*Ministry of Natural Resources and Tourism, P.O. Box 2404 Dodoma, Tanzania,* ***Correspondence Author**: E-mail address; hamza.kija@tawiri.or.tz*

1. Introduction

The Government of Tanzania, through the Wildlife Division (WD) of the Ministry of Natural Resources and Tourism (MNRT) and key stakeholders, established the *Wildlife Conservation (Wildlife Corridors, Dispersal Areas, Buffer Zones and Migratory Routes) Regulations (2018)* with a sole purpose of protecting and securing habitat connectivity in Tanzania. This regulation will support conservation efforts on the ground to ensure crucial connections between Protected Areas are maintained and structurally intact corridors allow free movement of wildlife through potential human-dominated landscapes.

In realization of the above regulation, the World wide Fund for Nature (WWF), through the Selous Ecosystem Conservation and Development Program (SECAD), with funding from UNEP/CMS and the KfW, German co-operation, and in collaboration with MNRT (WD, TAWA, TANAPA) and the Ruvuma region supported the Tanzania Wildlife Research Institute (TAWIRI) to undertake (i) Review of the historical and current biodiversity, land-cover data and identify the trends, threats, and scope of the corridor, (ii) Identify existing gaps and carry-out a medium and large-mammal survey, (iii) model the wildlife populations, (iv) determine the ecological function, and (v) Identify the precise boundaries and shape of the Selous-Niassa Wildlife Corridor (SNWC) for corridor planning models. In this poster, we present the progress related to this assignment.

2. Material and Methods

The Selous - Niassa Wildlife Corridor (9,000 Km^2) is located between 9° 52' 52" S to 11°46' 30" S and 35° 47' 34" E to 37°18' 20" E in the Ruvuma Region. It borders Nyerere NP in the north and Niassa Special Reserve (NSR) in Mozambique (Figure 1) in the south. The SNWC has three arms; The western arm, that provides connectivity to Liparamba GR, the central arm, that adjoins to the Niassa Reserve and the eastern arm that connects to Lukwika-Lumesule GR.

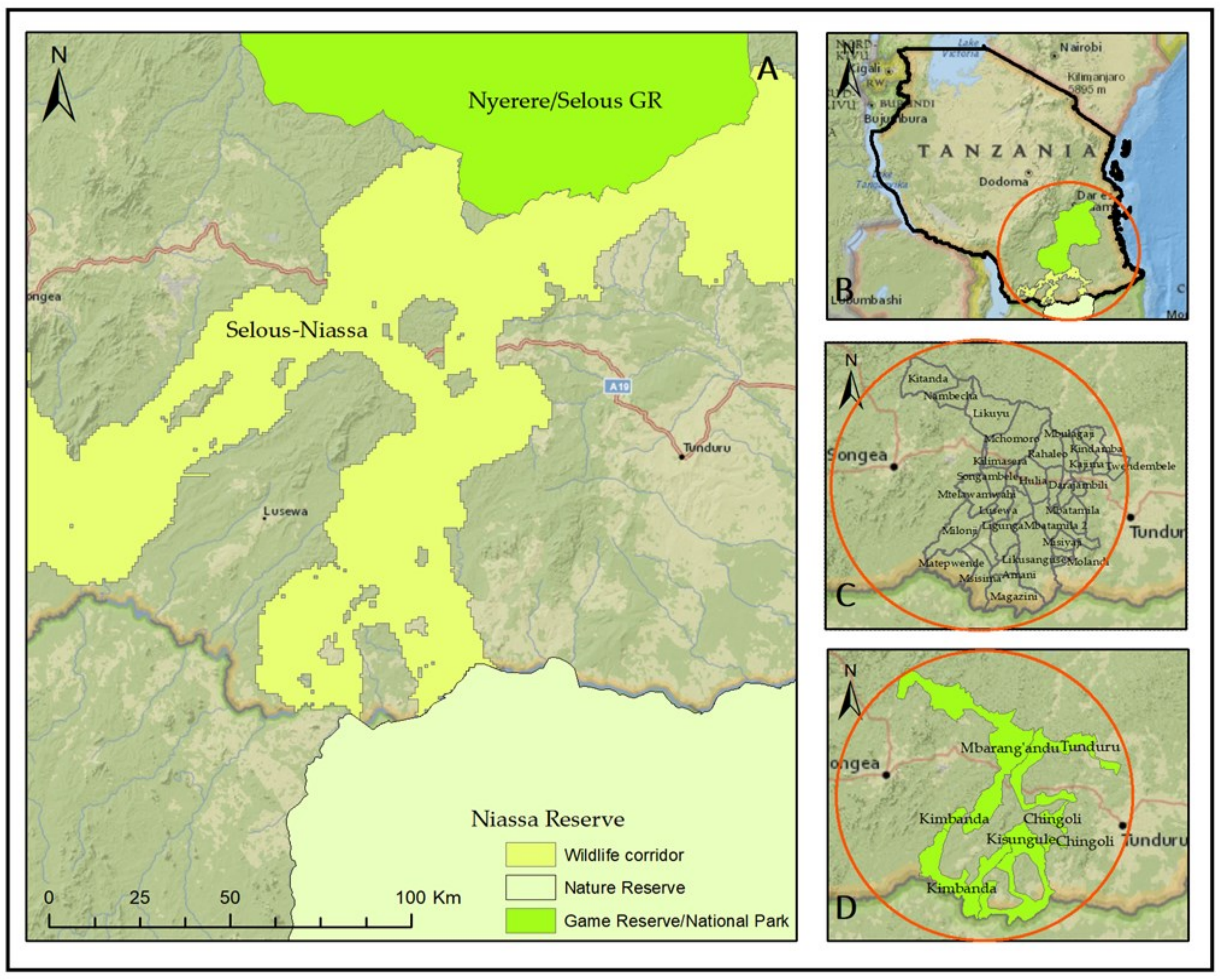

Figure 1: Study area map (A=Location of the Selous-Niassa Wildlife Corridor, B = In relation to Tanzania, C = Villages in the corridors' central arm, and D=WMA in the central arm).

2.1 Land use and land cover and Habitat characterization

Landsat-8 (Operational Land Imagery) images for the year 2020 covering the SNWC (Path 167 and rows 067 and 068) were downloaded from the Earth Explorer (https://earthexplorer.usgs.gov) and pre-processed (Kija *et al.* 2020). Random points (~100 samples per class), spaced at least 500 meter apart, were generated and traced on the ground using hand-held Garmin CSX GPS (Congalton 1991).

Random Forest (RF) in R software (Breiman 2001) was used for image classification. RF is a powerful machine learning classifier that has received wider acceptance in land-based remote sensing, with advantages such as; high classification accuracy, robust to noise compared to other classifiers and a non-parametric classifier (Cutler et al. 2007, Frakes *et al.* 2015). Land-use and cover characterization follow procedures summarized in figure 2.

Habitat quality of the SNWC is assessed using the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model. The quality of the ecosystem habitat is defined as a function of; (i) existing LULC, (ii) sensitivity of the habitat as a result of exposure to environmental threats.

In order to model the habitat quality, we collated ; (i) LULC (2020), (ii) Threat layer (roads, built-up, agriculture and human population), and (iii) sensitivity of each habitat threats with assumptions that areas with higher habitat quality are likely to support higher flora and fauna (Baral *et al.* 2014, Duarte *et al.* 2016).

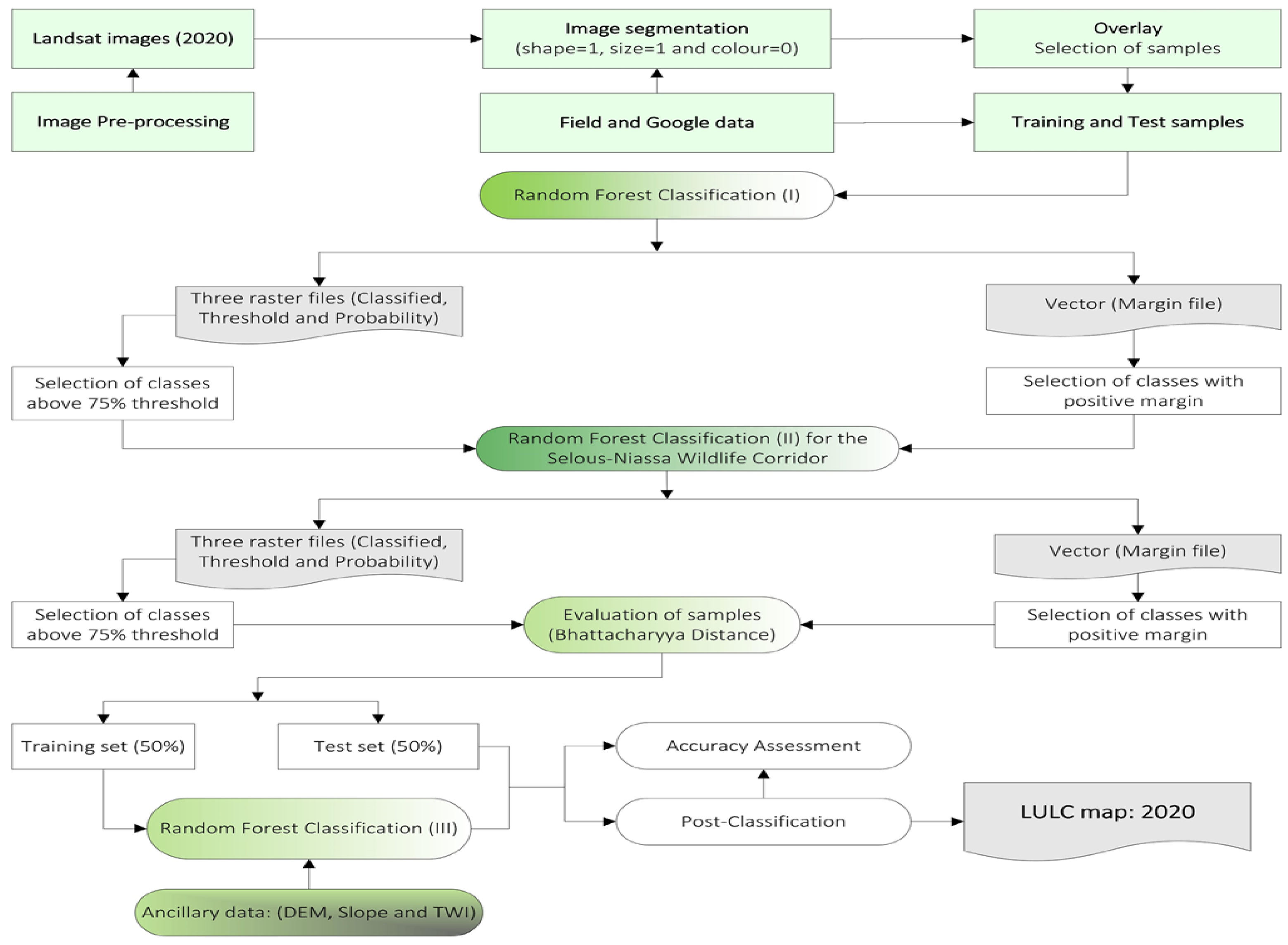

Figure 2: Methodological flow chart for land use and land cover characterization

2.2 Mammals species data

The following mammal datasets collected using (i) Systematic Reconnaissance Flight (SRF), (ii) Transect walk, and (iii) Camera trapping are used for determining the spatio-temporal distribution and species abundance in the corridor. Our target species are Elephant, Wild dogs, Lion, Buffalo, and Sable antelope. These species spatial distribution will be modelled using Species Distribution Models (SDMs).

2.3 Species Distribution Model

MARS multi-response species occurrence records for the above five key mammal species will be used based on its option to include sort of current and future species climate suitable areas .

2.4 Least Coast Path Modelling

The least-cost path (LCP) modelling approach implemented with Linkage Mapper Analysis Tool is used in assessing connectivity for multiple mammals species in combination with Species Distribution Modelling (SDM) and Expert based surface resistances. LCP analyzes specie's movement costs between habitat patches, an indication of mammal species' possible routes for dispersal (Adriaensen *et al.* 2003, McRae *et al.* 2008).

3. Way foward

This work is on progress, and expected to be completed by May 2022. Our intention is to model a set of corridors (though the main target is the central arm corridor) which balances wildlife connectivity and community development needs. A *safe corridor for people and wildlife* to be developed is expected to produce a balanced spatial corridor plan, and the methodology can be duplicated in other areas in Tanzania.

4. Funding

This work is funded by WWF through the Selous Ecosystem Conservation and Development Pro gram (SECAD) through KfW, part of the German co-operation and the UNEP-CMS, Convention of Migratory Species Project and the Conservation of Migratory Species (CMS).

5. Our request to readers

In order to achieve this project, we kindly request readers and other stakeholders who have worked in the Selous-Niassa Corridor to provide us with any spatial data as well as sharing any knowledge that could potentially improve this work. Any data or information, kindly share with; hamza.kija@tawiri.or.tz, cc: julian.easton@wwftz.org and fortunata.msoffe@maliasili.go.tz

TAWIRI
Tanzania Wildlife Research Institute

6. References

Adriaensen, F., J. Chardon, G. De Blust, E. Swinnen, S. Villalba, H. Gulinck, E. J. L. Matthysen. planning (2003). "The application of 'least-cost'modelling as a functional landscape model." 64(4): 233-247.
Baral, H., R. J. Keenan, S. K. Sharma, N. E. Stork and S. Kasel (2014). "Spatial assessment and mapping of biodiversity and conservation priorities in a heavily modified and fragmented production landscape in north-central Victoria, Australia." Ecological Indicators 36: 552-562.
Breiman, L. (2001). "Random forests." Machine learning **45**(1): 5-32.
Congalton, R. G. (1991). "A review of assessing the accuracy of classifications of remotely sensed data." Remote sensing of environment 37(1): 35-46.
Cutler, D. R., T. C. Edwards, K. H. Beard, A. Cutler, K. T. Hess, J. Gibson and J. J. Lawler (2007). "Random forests for classification in ecology." Ecology 88(11): 2783-2792.
Duarte, G. T., M. C. Ribeiro and A. P. Paglia (2016). "Ecosystem services modeling as a tool for defining priority areas for conservation." PLOS ONE 11(5)
Frakes, R. A., R. C. Belden, B. E. Wood and F. E. James (2015). "Landscape Analysis of Adult Florida Panther Habitat." PLOS ONE 10(7).
Kija, H. K., J. O. Ogutu, L. J. Mangewa, J. K. Bukombe, F. Verones, B. Graae, J. R. Kideghesho, M. Y. Said and E. F. Nzunda (2020). "Land use and land cover change within and around the Greater Serengeti Ecosystem, Tanzania." American Journal of Remote Sensing 8(1).