LONG TERM ECOSYSTEM AND LANDSCAPE DYNAMICS IN EAST AFRICA

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INTRODUCTION

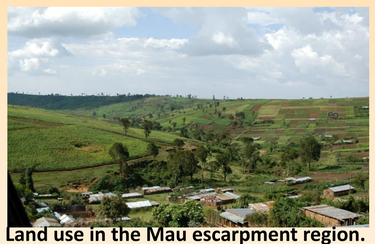
Ecosystem dynamics are continuous processes driven by multiple interacting factors at various spatiotemporal scales. Long-term visualisation of ecosystem changes can be used to determine disturbance and ecosystem responses. Palaeoenvironmental analyses at variable temporal scales provide an important perspective to ecosystem management as they offer insight into changes that have occurred over a long time period.

The current state of the ecosystem and landscape is attributed to human and climatic impacts on the ecosystem. East African ecosystem dynamics have been studied, however there are few high temporal and spatial resolution data sets. This study aims to provide a high temporal resolution multidisciplinary synthesis of the ecosystem changes since the late Holocene in East Africa.

STUDY SITES

- The **Amboseli ecosystem** located in Eastern Kajiado District, Southern Kenya, is approximately 3000 km^2 and is a semi-arid savannah experiencing bimodal rainfall distribution caused by the movement of the Intertropical Convergence Zone-ITCZ (Hulme, 1996, Swift *et al*., 1996). It lies in the rain-shadow of Mt. Kilimanjaro and rainfall varies from 350 mm y^{-1} to 500 mm y^{-1}, with higher rainfall amounts falling closer to the foothills where altitudes are greater (Githaiga *et al.,* 2003). Altmann *et al.* (2002) reports that both the maximum and minimum diurnal temperatures in the Amboseli basin have risen by 0.28°C and 0.07°C, respectively, between 1971 and 1996.
- The **Mau ecosystem** is a forest complex in the Rift Valley of Kenya that has undergone serious deforestation. It is the largest indigenous montane forest in East Africa and the complex has an area of 273300 ha. The forest area has some of the highest rainfall rates in Kenya. Numerous rivers originate from the forest, including Ewaso Ng'iro River (southern), Sondu River, Mara River and Njoro river.


Ewaso Ng'iro


Land use in the Mau escarpment region.


Njoro river

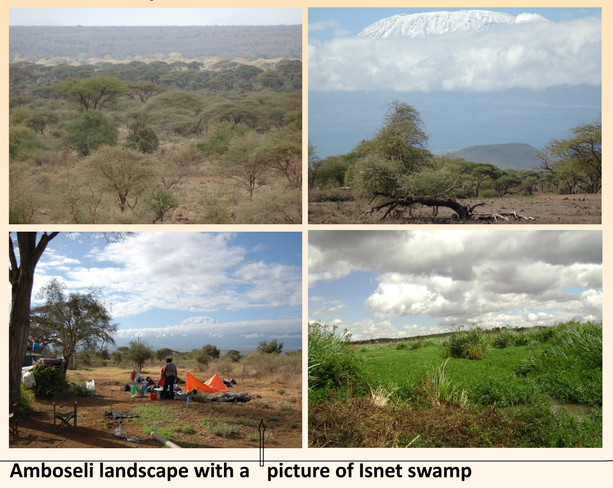
Location of Mau escarpment on Kenyan map

Location of study sites in Amboseli Kenya.


Namelok swamp


Esambu swamp


Isnet swamp


Amboseli landscape with a picture of Isnet swamp

APPROACH

The study will follow a multi-proxy approach to investigate long term temporal and spatial changes in ecosystems, landscapes and societies caused by climate change and human land use in Kenya.

Provide a **decadal-to-centennial scale resolution history of the East African ecosystem during the late Holocene**. The data will be important in understanding how these ecosystems have responded to human, climate and environmental interactions and how they may respond to future climate change and human land use. This Will be achieved through the following:

PALAEOECOLOGICAL METHODS:

- Determining and reconstructing the vegetation changes, fire regimes and climatic changes over time through pollen/charcoal analysis.
- Identifying societal activities such as pastoralism, agriculture, burning, soil erosion through the use of indicator fungal spores (**Figure 6**), charcoal (**Figure 5**) and vegetation data (**Figures 1-4).**
- Physical/chemical sediment analysis (carbon isotopes, C:N,bulk density, particle size analysis,) providing signals of local environmental changes.

SYNTHESIS:

- Documenting the environmental changes along an age depth model and comparing them with available historical archive analyses and archaeological information.
- Investigating the impacts of climate change and human land use on the landscapes and societies and their responses using the multi proxy data acquired e.g. **Figure 7,8,9**

MODERN ECOLOGY STUDY:

- Vegetation surveys to determine present day species composition and modern pollen data used in modelling pollen vegetation relationships.

POLLEN IMAGES


Figure 1: *Typha australis*

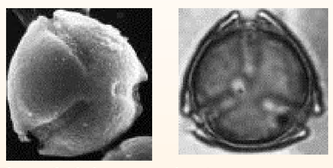


Figure 2: *Solanum aculeastrum*

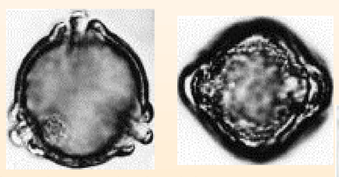


Figure 3*: Hagenia abyssinica*

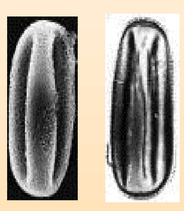


Figure 4: *Acanthus pubescens*

CHARCOAL IMAGES:

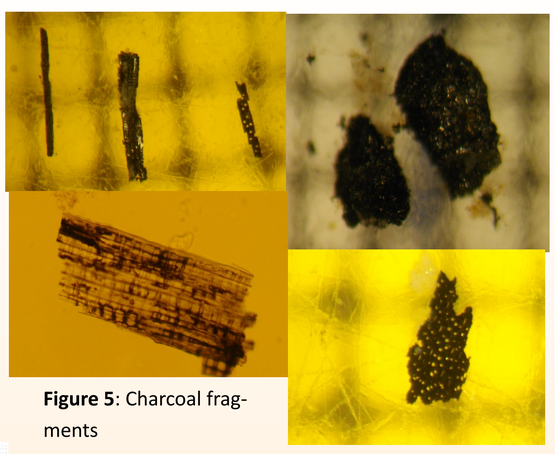


Figure 5: Charcoal fragments

FUNGAL SPORES:

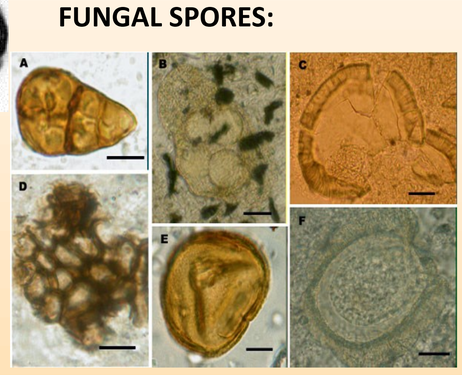


Figure 6: Fungal spores

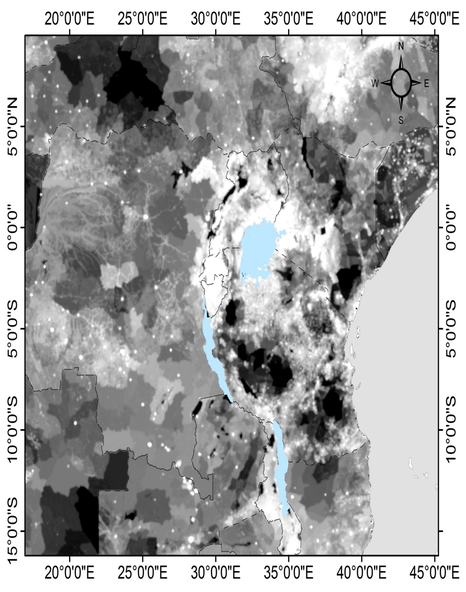


Figure 7: Population pressure exerted on the landscape

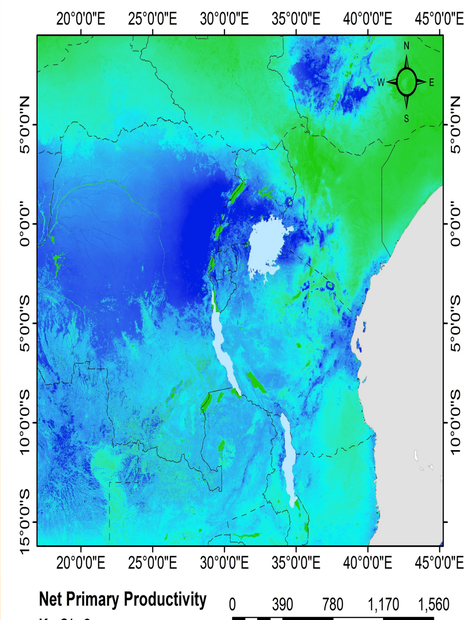
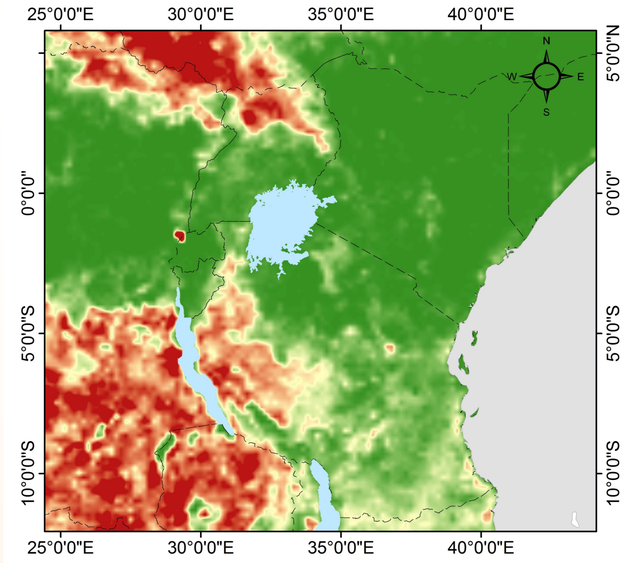


Figure 8: Aridity index (mean annual precipitation/mean annual potential evapotranspiration



Fire Frequency
10 year average
High
Low
Figure 9: Annual Fire hotspots


Landscape fires in Africa.
Figure 10: Savanah fire


Figure 11: Forest fire Africa,

APPLICATIONS and SIGNIFICANCE

- Samples will be taken at close intervals for analysis, allowing a picture of change in the wetlands and surrounding landscape over time and explaining the association with available archaeological and historical archives.

These analytical techniques have proven powerful in establishing the impact of phenomena and discerning the effects and timing of human disturbance on the surrounding environment at the same time as establishing the nature of local resources available to human settlements.

- The synthesis of ecological, archaeological and historical perspectives during the study will **provide information of the ecosystem changes in East Africa from the late Holocene**. The information is important to different stakeholders such as : **resource management policy developers, local communities affected by extreme landscape changes, government agencies involved in resource management, scientists involved in understanding environmental changes through time by providing new data sets and modellers interested in future scenario building.**

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http://www.real-project.eu/

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REAL

MARIE CURIE ACTIONS

SEVENTH FRAMEWORK PROGRAMME