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Workshop summary

Training in emerging palaeoenvironmental methods to study East African ecosystem dynamics

Introduction

Palaeoecology is an increasingly important discipline for understanding East African ecosystem dynamics, particularly as environmental gradients are steep and cultural and biological diversity high. Over 50 years of palaeoecology is now revealing a good understanding of the spatio-temporal variability of ecosystems in the region and providing insights into questions such as: why do certain mountain ranges have greater biological diversity than others (Fjeldså et al. 1997)? how important are fires in shaping ecosystem composition (Schwilk et al. 1997)? and, how has the historical decline of elephant populations, associated with the rise of caravan trades, impacted ecosystems (Håkansson 2004)? Combined with a rich tradition of archaeological studies in the region we are starting to contextualize and unravel past human-environment interactions. Yet, the complexity of socio-ecological issues demands the synergy of international and multi-disciplinary collaborations for appropriate solutions. During 17–20 March 2014, a joint workshop between the National Museums of Kenya (NMK) and the training component of a multi-institutional Marie Curie Initial Training Network (ITN) entitled 'Resilience in East African Landscapes' (REAL) was held at NMK, Nairobi, Kenya. The workshop was developed as a forum for international networking across institutions, disciplines, and nations, and for capacity development in palaeoenvironmental research. There were 17 participants that included early-stage researchers (ESRs) from REAL and NMK who are working in archaeology, geology, palaeobotany, palaeoanthropology and palaeontology (Figure 1). Participants' experience ranged from interns, postgraduates, junior and senior researchers. The workshop included a speech from the Director General of NMK, who discussed the strategies of the museum to further develop multi-disciplinary collaboration within the institution, government institutions, and to further internationalise with external partners.

Figure 1. Participants of the joint REAL project and National Museums of Kenya palaeoenvironmental science workshop, March 2014.

Purpose of the workshop

It is increasingly acknowledged that recent and predicted future environmental changes need to be understood within longer-term contexts that are provided through the study of past environments (Willis and Birks 2006). Past environmental conditions can be interpreted by analyzing natural archives (such as swamp and sediment cores; Smol 2008), archaeological data sets (e.g. site distributions and assemblages, bioarchaeological and geoarchaeological records), and evidence from historical approaches (archival evidence, maps, air photographs, and satellite imagery; Gillson and Marchant 2014). These types of data are critical to our understanding of how past ecosystems evolved and interacted with human activities. This workshop explored aspects of palaeoenvironmental approaches to understanding environmental change; the purpose was to foster interdisciplinary understanding, collaboration, and the sharing of resources. Advances in pertinent numerical methods using open-source software were central to the groups' practical components. The networking of researchers interested in ecosystem dynamics and human interaction in East Africa is crucial to fostering constructive relationships to facilitate research collaboration, planning field work logistics, and the sharing and pooling of resources such as data, maps, reference collections, and knowledge.

Content and structure

The focus of the workshop was the development and critical interpretation of palaeoenvironmental records in East Africa and the design of multidisciplinary studies aimed toward understanding the relative importance of anthropogenic and natural influences in these ecosystems. The first days consisted of introductory lectures by Stephen Rucina and Colin Courtney Mustaphi on palaeoenvironmental approaches to studying past environmental variability, ecosystem processes, and entangled human-environment interactions. The content began with basic theory, site selection criteria, and geochronologies. These were followed with lectures on specific proxy analyses of pollen, charcoal, phytoliths, and fungal spores, for vegetation reconstructions of interest across multiple disciplines. Following the lectures, computer-based sessions addressed the creation of chronologies using R language (R Project contributors 2014) packages `CLAM` and `BACON` (Blaauw 2010, Blaauw and Christen 2011) as well as Matlab-based CharAnalysis code (Higuera et al. 2009). Lectures then continued and contextualized these types of proxy data for tackling research questions in modern landscape-scale ecology, land cover change, and conservation. Additional presentations by Rob Marchant explored concepts of biomes, biomization, plant functional groups, and the analysis of proxy data. The proxy-record content closed with sessions for using C2 software (Juggins 2007) to visualise multivariable data and students were encouraged to plot their own datasets. The programme then continued with introductory mapping and cartographic concepts, and the use of field-based GPS and how to incorporate field data with other remote sensing products. To complete the workshop, lectures on communication of science to diverse audiences, scientific writing, and figure design, were discussed. A guided tour through the Archaeology, Palaeoanthropology, and Palynology and Palaeobotany sections of NMK provided an opportunity to see ongoing projects, collections, and important artefacts of Kenyan and human heritage.

There was ample time for open-floor discussions throughout the workshop, which ranged on topics from the practicalities of fieldwork in East Africa, palaeoecological data interpretation, and career development. Current research questions rely on information drawn from numerous disciplines and generally combine components from field- and laboratory-based methods, remote sensing, qualitative analyses, and synthesis of decades of previous data gathering. Skills development in geospatial data collection, analysis, and visualization was identified as a major area of future focus for all disciplines and career stages. Students and experienced researchers showed strong interest in field methods for collecting geospatial data in the field, manipulating large datasets, various spatial analyses (such as Ripley's K function analysis of point data for archaeological

site locations), and the creation of publication-quality figures in graphing and graphics software. This was mirrored by discussions with employees of the Survey of Kenya, who are actively working toward centralising geospatial data in Kenya, have developed a geospatial training institute, and are increasingly developing clientele from the federal government, private sector, and researchers. Future capacity-building training in East Africa related to ecological and social research, data handling and sharing, and scientific career development should include training in geospatial research methods.

Lessons learned

This workshop was successful at mixing the training requirements for the REAL Initial Training Network project and provided an opportunity to train interns and employees of NMK. It brought together an international group from seven nations with a wide range of experience and backgrounds. The workshop was a true forum to build new professional relationships, to foster discussion, and sharing of difficult to access resources; such as data, maps, translations, contacts, and historical knowledge. Research in East Africa requires centralisation and improved accessibility of data resources in formats readily usable by researchers across multiple disciplines. Investments in East African scientists also will accelerate capacity for palaeoenvironmental research through international training (Showstack 2014), as will continued interaction with organisations that support research, such as the British Institute of East Africa (BIEA) and the French Institute for Research in Africa (IFRA).

Future capacity-building workshops in East Africa related to studying human-environment-ecosystem interactions would benefit from a strong geospatial component, as well as discussions and activities related to data visualization, publication and communication, and further development of resource sharing and collaboration. It is clear that future ecological, biogeographical and socio-environmental advances in the region will require detailed studies that include palaeoenvironmental, remote sensing and imagery, and humanities data, in conjunction with a modeling framework exploring human-environment-ecosystem interactions. It is crucial that outputs from such developments be in a format that can be digested by researchers from multiple fields. Moreover, these outputs need to be communicated in an appropriate format so that such insights can inform decisions and policy on topics such as ecosystem changes in the face of predicted climate changes (Platts et al. 2014) and how changes in livelihoods impact ecosystem compositions and distributions (Muchiru et al. 2009, Stump 2013). Readers are encouraged to view additional information at www.real-project.eu

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