Afromontane ecosystem stability or change? Combining methodologies to understand past, present and future ecosystem shifts within the Eastern Arc biodiversity hotspot of Tanzania and Kenya

2009 IOP Conf. Ser.: Earth Environ. Sci. 6 072043

(http://iopscience.iop.org/1755-1315/6/7/072043)

P07.31

Afromontane ecosystem stability or change ? Combining methodologies to understand past, present and future ecosystem shifts within the Eastern Arc biodiversity hotspot of Tanzania and Kenya

Rob Marchant(1), A Ahrends(1), J Finch(1), A Jump(1), J Lovett(1), C McClean(1), C Mumbi(2), P Platts(1), P Yanda(3)
(1) York Institute for Tropical Ecosystem Dynamics (KITE), University of York, UK
(2) Tanzanian Wildlife Research Institute, Arusha, Tanzania
(3) Institute of Resource Assessment, University of Dar es Salaam, Tanzania

The Eastern Arc Mountains of Tanzania and Kenya support great floral and faunal diversity and provide a range of ecosystem services to surrounding populations. Questions of why the Eastern Arc Mountains are so species diverse, have more than their fair share of endemic species if such biological wealth was retained under past climate changes, and how this will this change into the future is being investigated by applying palaeoecology, biogeography, genetic and modelling methodologies to explore relationships between Eastern Arc Mountain ecosystems, climate change and human impacts. Research results are starting to show why the Eastern Arc is so biodiverse, the role that past human impacts and current management strategies impart, and how this may change under future climate change, land-use and economic scenarios. We show that the high levels of biodiversity in the Eastern Arc Mountain ecosystem depend on buffering from global climatic changes, due to the close proximity of the Indian Ocean monsoon system (Mumbi et al., 2008), and the importance of steep gradients of climatic and environmental variability in creating a wide range of habitats (Platts et al., 2008). Botanical data within some 2500 plots from 40 years of field-based ecological surveys along the Eastern Arc Mountain by individual botanists, governmental and non-governmental organisations are being analysed to determine biogeographical patterns across the Eastern Arc Mountains. Our understanding of species distribution patterns is being investigated by assessing impacts of different survey methods, the degree of botanical skill, and the circularity between funding, research intensity and patterns of species richness. Not surprisingly, areas with the highest levels of funding and subsequent research intensity also have the highest levels of species richness and endemism! This reassessment of the current understanding of Eastern Arc ecosystems is vital as it is upon such ecological foundations that forest management strategies are developed and applied. This area of KITE research is being complemented by an investigation of genetic diversity across the mountain archipelago; preliminary results are showing incredible sub-species diversity supporting the suggestion that these ecosystems have been isolated from adjacent Afromontane forests for a considerable length of time. Again these insights have a practical application by providing information that will feed into an assessment of future forest fitness within forestation schemes, as well as developing our understanding about past ecosystem connections between the presently isolated montane blocs. To assess future impacts it is necessary to construct and apply models that are appropriate to the research questions and environmental scale under investigation. In addition to providing 'what if scenarios?' model developments within KITE address several issues that interface between archaeology, plant ecology, biogeography and geophysical aspects of climate change appropriate for East Africa. A niche-based model has been developed for the Eastern Arc Mountains that takes a suite of environmental parameters (e.g. temperature, precipitation, altitude, aspect, seasonality) correlated with observed distributions on plant species. Model results use the match between observed and generated distribution to determine spatial extent of the niche occupied by a given species climate envelope (Platts et al., 2008). This modelling framework is then used to assess future climate impacts on individual taxa or overall ecosystem. Implications for Eastern Arc ecosystems of land use and economic change are also being investigated; the latter in collaboration with a separate initiative entitled 'Valuing the Arc': a consortium of UK, USA and Tanzanian institutions providing an environmental audit for the Eastern Arc Mountains under different environmental and economic scenarios. Numerous collaborations ensure that KITE output can be useful in areas such as conservation biology, investigating carbon budgets, developing biogeographical theory and long-term planning of Eastern Arc ecosystems. To disseminate research findings, and inform future Tanzanian decision makers, KITE is integrating research findings within taught courses at the Institute of Resource Assessment, University of Dar es Salaam. Thus, collaboration amongst archaeologists, ecologists and modellers is providing a series of new insights into one of the worlds biodiversity hotspots. Such a combined approach is leading to some new insights into the full range of past variability and how this may project to future scenarios that are vital for conservation biologists, resource managers and politicians to develop effective long-term management strategies.

References Mumbi, C., Marchant, R., Hooghiemstra H, Wooller, M. 2008. Late Quaternary vegetation reconstruction from the Eastern Arc Mountains, Tanzania. Quaternary Research 69, 326-341. Platts, P. McClean, C., Lovett, J., Marchant, R. 2008. Predicting tree distributions in an East African biodiversity hotspot: model selection, weights and space. Ecological Modelling