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Historical ecology perspectives of change at Amboseli, Kenya

Abstract

A historical ecology perspective helps us understand the long-term interaction between human societies and their social and natural environments by integrating approaches from across the physical and social sciences. Through a multidisciplinary lens, an in-depth examination of the history and processes of human-environmental interactions is possible.

The rapid and intense rates of transformation of land cover in the Amboseli area of southern Kenya are having massive impacts on the social and ecological landscape and the interaction between conservation and local livelihoods. A detailed look at the recent past helps to inform the possible future trajectories of land cover/land use and biodiversity changes and the interacting relationships between humans and the environment through time.

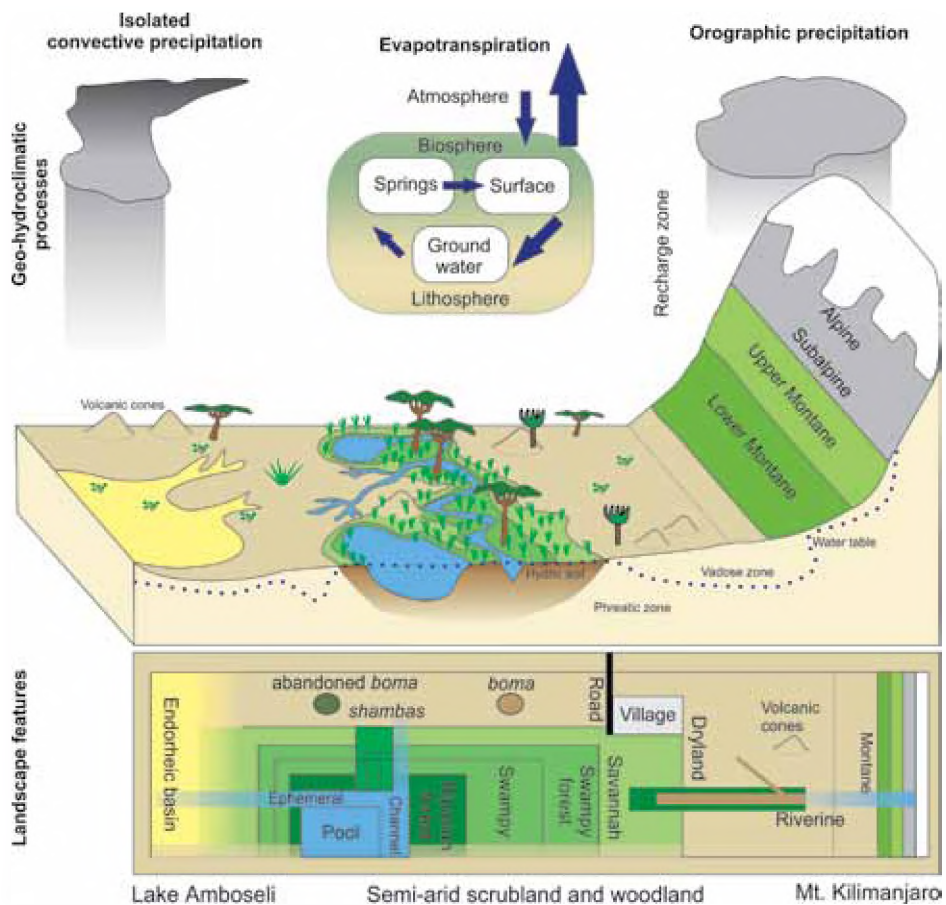


Figure 1. A schematic representation of the major components of the Amboseli ecosystem. A cross sectional view at top and plan view of the natural and human components that influence the land cover and biodiversity. In reality the components grade into one another and the interactions are complex. A multi-disciplinary approach to studying the natural history, human history, and processes linking these components together can help us to understand what controls future land cover and biodiversity.

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The Amboseli area is immediately north of Mount Kilimanjaro near the Kenya-Tanzania border and is currently experiencing rapid land cover and land use changes with implications for the resilience of biodiversity and social-ecological systems. In recent decades, the wetland catchments outside of the Amboseli National park have notably experienced dramatic changes in land tenure, land use and vegetation cover that result from the ways these ecosystems are integrated into the livelihood strategies of the population (Turner *et al.*, 2000; MEMR, 2012). These current changes are superimposed on the legacies of historical land use activities, climatic variability and environmental interactions (Rucina *et al.*, 2010). But how has the history of these factors influenced the biodiversity and ecosystems we see today? And, how has this influenced the available ecosystem services and uses for all stakeholders present on this landscape? What will future trajectories of these complex systems be like given continued population increases, land privatization pressures, and climate change impacts?

This history of land cover development and human-environment interactions since the end of the African Humid Period ending (~6000-4000 yrs BP) is being studied within the ongoing Resilience in East African Landscapes (REAL) project. These investigations involve establishing palaeoecological records from a number of swamp sites by examining the vegetation histories through plant pollen, fungal spore, sedimentological and charcoal analyses of the swamp sediments. These data are examined together with archaeological and historical research that illuminates the relationships between people and their environment. Additional detail about recent changes come from census data, animal population counts, satellite and air photo images of regional land cover changes, and computer modelling of how landscape components interact. Equally important is understanding how socio-political aspects of land tenure and land use policies, such as food (in)security, political stability, and perceptions of conservation and industrial agendas, have influenced relationships with the landscape.

Although Lake Amboseli is presently dry, water is available year round in a series of groundwater-fed wetlands spread across the semi-arid woodland and scrubland. Moisture derived from the Indian Ocean precipitates over Mount Kilimanjaro and the Chyulu Hills that surround the Amboseli region. The water enters the porous volcanic bedrock before flowing from springs between 1120-1220 m asl elevation that support the wetlands in Amboseli (Williams, 1972; Meijerink and Wijngaarden, 1997). These wetland areas support both wildlife and pastoralist communities in the region, particularly as they form a 'constant' supply of water and become crucial grazing refuges during drought periods (as was seen in 2008-2009). New pollen records from Namelok and the north part of Kimana

swamp suggest that the region was relatively dry from 4000-1700 years BP, being dominated by grasses, Amaranthaceae, and semi-arid plants (unpublished data). By 2000-1700 years BP there is evidence of increased moisture at both sites that has dominated to present with some variability, and that variability in moisture availability may have increased over the past 500 years. There is emerging evidence that these swamps have expanded, contracted and have even shifted in their position upon the flat landscape. Thus, over the late Holocene, since the end of the African Humid Period, moisture availability has been variable, and this hydroclimatic variability has been linked with regional scale climatic drivers, particularly Indian Ocean-terrestrial interactions. The new palaeoecological records will provide data to improve understanding of the changes in vegetation, fire history, climatic and sedimentological processes that inform ecological, water and grazing resource management. Hydrological variability has not been the only major change during the late Holocene; anthropogenic impacts on animal populations has been a key control on the present composition and distribution of the Amboseli ecosystems, through the historical decimation of elephant population via the ivory trade and transition and expansion of pastoral communities.

Archaeological studies in the region are bringing new insights into the complexities of human-landscape interactions and how the ecosystem has changed due to the presence and agency of humans. Archaeological research in the nearby Tsavo region suggests that a transition to generalized pastoralism occurred in south-eastern Kenya around 3800 years BP (Kusimba and Kusimba, 2005; Wright, 2005). After 3000 years BP, Pastoral Neolithic sites are found distributed throughout all of East Africa; however, transitions to pastoralism in East Africa was an irregular process characterized by shifting identities between herders, cultivators, and hunter-gatherers (Lane, 2004). The uneven adoption of pastoralism suggests not an immediate integration event between immigrating herders and resident hunter-gatherers, but varying degrees of social interaction and exchange that developed over millennia (Lane, 2013) and environmental impacts and responses that are challenging to fully discern. Further understanding of the trajectory of human-environmental interactions is constrained by the limits of thin documentary source material and oral histories available for the area. Yet, prior to European settlement, people on the Amboseli landscape engaged with vast trade networks stretching across the continent to Arab, European, and Asian cultural spheres. This included links to the ivory trade which peaked during the 1800s and drastically impacted the ecology and landscape of Amboseli.

The first Maasai *olosh* (local organizing land ownership unit) to reside in the basin was



Figure 2. Pastoral herds drinking water in Engong Narok swamp during the dry season, September 2015. Photo by Anna Shoemaker.

probably the Loogalala who were resident by the 18th century (Galaty, 1993). The Kisonko Maasai likely arrived in the area during the 19th century, as they were expanding southwards through the attractive permanent water sources and pastures of the central Rift Valley. It has been proposed that when the Kisonko encountered the Loogalala the latter were either assimilated or evicted (Western, 1983; Galaty, 1993). Maasai pastoral economy has long been situated within a wider regional socio-economic system, which included foraging, hunting, trade, agro-pastoralism and irrigation and rain-fed cultivation (Galaty, 1993). Some Maasai participated in hunting for animal products (Meyer, 1900) and hunting along caravan routes passing near Mount Kilimanjaro would have been extensive enough to result in heavy regional defaunation (Håkansson *et al.*, 2008). Maasai had long been shaped by a shifting regional socioeconomic sphere moulded in part by competition over water and pasture. Furthermore, while Maasai identity centres in many ways upon a pastoral livelihood, historical and contemporary economic activities exhibit great fluidity between individuals and throughout an individual's life, all of which have variable cumulative influences on biodiversity and land cover.

The establishment of Amboseli National Park has conserved a number of the wetlands at the lowest elevations from being converted to agricultural land. Tourism and conservation in the region also provides some economic benefits as well as educational and health facilities and infrastructure for local populations. The National Park space has also enabled the maintenance of large numbers of wildlife that are able to migrate out of the protected area through the surrounding landscapes, particularly towards Tsavo to the east and Tanzania to the south. This

interaction between an increasingly sedentary human population and migrating wildlife presents potential for conflict with local populations that must be considered when drafting management plans. Across the region, there is a finite space for aquatic and riparian taxa distributions to shift and regional connectivity of animal populations relies on community support and sound sustainable policies (Western, 1982). Even for the mobile large herbivores, range contractions can be a serious threat to populations (Ripple *et al.*, 2015) and lead to intensification of human wildlife conflicts, and changes on vegetation distributions also impact migratory grazers, both wild and domestic (Western, 2007). Predator resilience in particular relies on a sustained population prey, available niche spaces, and compensation schemes that buffer local Maasai people from inevitable cattle losses (MacLennan *et al.*, 2009; Okello *et al.*, 2014). In some plots, indigenous ruderal taxa grow amongst commercial crops, producing novel vegetation assemblages (Hobbs *et al.*, 2009). Since the 1980s, Isinet, Namelok, Esambu and Kimana swamps have been largely converted to agriculture and diverted to irrigation schemes covering areas of <1 km to 45 km² (KWS, 2008). This conversion has coincided with decreased livestock holdings as herders navigate issues of land access, food, and economic insecurity. Increasing populations and the expansion of cultivated and conservation areas have limited access to watering points and pastureland.

Wholesale conversion of wetlands to agriculture is occurring in other regions of Kenya and has profound implications for biodiversity and habitat loss (MEMR, 2012), as well as socio-economic restructuring of human populations. While it must be acknowledged that livestock herders in Amboseli have long practiced flexible production strategies articulated with wider regional

markets, the rate of expansion of cultivated land in recent years is unprecedented in the area. The growth of the agricultural sector in Amboseli has had enormous impacts on wetland areas and human-environment interactions. The impacts of these changes directly influence biodiversity at the genetic to population levels through changes in soil characteristics, habitat conversion and loss, human pressures, and reductions in natural connectivity of populations and associated gene pools. The consequences of such changes are reduced ecological resilience and curtailed capacity for ecosystem restoration and recovery of animal populations from increasing intensive and pervasive limitations to water access during droughts. Additionally, the present trend toward privatization of land in Amboseli continues to restrict land access and the poorly regulated process of subdivision and sale is exacerbating disparities in wealth accumulation and provisioning of social services. Social consequences also include

changes in the relationship between people and their livestock. As land use strategies shift, cattle holdings in Amboseli are declining and sheep and goat populations increasing. This has enormous implications for perceptions of identity for the Maasai in Amboseli who espouse that their cattle are the essence of their financial, nutritional, and cultural security. Understanding the history and development of human-environmental interactions plays a crucial role in understanding how the social-ecological system in Amboseli has evolved. Such a historical ecology perspective is being used to guide project future land cover/land use changes in the region to inform developments in sustainable human livelihoods and strengthen conservation objectives of the globally important Amboseli landscape.

For more information about the project, see: www.real-project.eu

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