Introduction

Conservation policies across Africa often lack important information pertaining to long-term environmental change and patterns of land-use (e.g. Brockington and Homewood 2001; Gillson and Lindsay 2003; Leach and Mearns 1996). Without this requisite knowledge, it is difficult for policy-makers to implement effective land-use management schemes to protect both wildlife and the ecological patterns that sustain them. At the same time, local concerns regarding ancestral rights to land, natural resources and other kinds of common property must also be addressed, along with broader desires for poverty alleviation and sustainable development. Demographic expansion, combined with disparate new land-use practices, earlier inequitable decisions of land allocation and increased modernity, among other factors, have all helped create intense pressures which, especially in semi-arid regions, may exacerbate erosive processes induced by human activity. Not surprisingly, then, debates over land-use in many parts of Africa are highly contested.

The Laikipia Plateau

The Kenya element of the project was principally concerned with reconstructing patterns of pastoralist activity and their long-term environmental effects. Laikipia was chosen for at least three reasons. First, prior to the commencement of the project, systematic archaeological studies were limited to surveys and excavations in the area around Kisima Ranch during the 1970s (Siräinen 1977, 1984) and a more recent analysis of site distribution in the Mukogodo Hills (Dickson et al. 2004). A primary objective was therefore to augment the level of archaeological knowledge about the study area.

Second, the geographic position of the Laikipia Plateau on the eastern side of the Great Rift Valley, immediately south of the Lake Turkana Basin, likely made it a critical zone for the southward expansion of pastoralism some four to five millennia ago. Traces of Elmenteitan and later pastoralist remains were noted by previous researchers, and the area is known from oral traditions and documentary sources to have been a centre of pastoralist activity during the 18th and 19th centuries (e.g. Galaty 1991; Sutton 1993; Waller 1979). However, neither the intensity nor the nature of early pastoralist activity (i.e. that conventionally associated with the East African Pastoral Neolithic) on Laikipia, or the subsequent transformation and/or replacement of these groups during
Figure 1. (Upper Right) The position of the Laikipia Plateau within East Africa on the eastern side of the Great Rift Valley, immediately south of the Lake Turkana Basin, probably made it a critical zone for the southward expansion of pastoralism some four to five millennia ago. (Center) The BIEA project located over 200 archaeological sites, mostly on Mugie (pictured upper) and Lolldaiga Hills (pictured lower) Ranches.
the second millennium AD were fully understood. By focusing on the evidence for pastoral activities, the project hoped to provide sufficient data to answer some of these questions and to contribute to ongoing debates as to when Maa-speakers first arrived in this area. Lastly, while a number of groups and land-use practices may contribute toward environmental change on Laikipia today, pastoralist groups have been most frequently blamed for recent land degradation (Figure 1).

The situation is considered exigent because if policy-makers continue to be unaware of how various land-use practices might impact the environment over the long-term, then certain vegetation patterns may disappear and eventually so will the wildlife. Pastoralist communities were forced to leave Laikipia between 1911 and 1913 by the colonial authorities, and large tracts of land were allocated subsequently for commercial farming and ranching. This inevitably changed older and more ‘traditional’ patterns of seasonal grazing, settlement location and migration, and restricted different pastoralist communities to smaller areas of rangeland. Consequently, it was also important for the project to assess whether some of the perceived impacts of pastoralists were in fact due more to changes in patterns of land-ownership than to patterns of land-use. The best way of achieving this, it was felt, was by investigating the nature of pastoral practices on Laikipia under different climatic, economic and socio-political conditions over the last four- to five-thousand years.

Why GIS and Landscape Archaeology?

GIS and landscape archaeology are an apposite combination to assess the possible long-term environmental effects of pastoralism on the Laikipia Plateau because many activities occur away from residential sites and so leave traces - albeit often very ephemeral ones - scattered across the landscape, rather than just localized concentrations, or ‘sites’. The changing composition, distribution and locational parameters of these varied traces can be modeled in GIS and compared with evidence for environmental change. Indeed, GIS and landscape archaeology may be considered concomitant; the two are so conjoined that in the early 1990s it was predicted that without the use of GIS, landscape archaeology might eventually become a dead end (Green 1990; Savage 1990). The power of the two is realized when human behavior is spatially analyzed within the landscape and later modeled in GIS. A GIS model has been defined as a “simplification (which we understand and can manipulate) of an aspect of complex reality (which we don’t understand and can’t manipulate)” (Lock 2003:147). In this sense, a GIS model is a viable way to illuminate human behavior that might otherwise be difficult to comprehend. This is particularly true for pastoralist activities that occur away from sites within the wider landscape without any explicit contextual associations, so that an added element of complexity is inherent. It is our hope that by generating such models, the combination of GIS and landscape archaeology will be able to delineate the possible long-term environmental effects of pastoralism on the Laikipia Plateau (some of which may well be beneficial to the creation of biodiversity), in a way that can better inform non-specialists such as policy-makers.

Preliminary Results

The BIEA project located a total of 223 archaeological ‘sites’ on the Laikipia Plateau between 2002 and 2004. These included rock shelters, stone cairns, surface scatters, ash and refuse middens, iron smelting furnaces, and rock paintings. A series of judgmental and systematic transect surveys were conducted, with most fieldwork concentrated on two ranches: Mugie in the north, and Lolldaiga Hills toward the southeastern edge of Laikipia (Figure 1). More limited work was conducted on Borana, Mpala, Chololo and Jessel’s Ranches, and it is hoped that at least some of these, along with Enasoit and Kisima and sections of the Mukogodo Forest Reserve will be investigated more systematically in future years. Most of the sites were found on Mugie and Lolldaiga, and in terms of the chronological range the greater proportion of sites (about 60%) probably date, on typological grounds and from the few available C-14 dates, to the last one thousand years (Lane, in press).

Using their GPS co-ordinates, each site was placed into an environmental context in GIS using vegetation maps and vertical aerial photographs. The vegetation maps revealed 205 sites within vegetation labeled ‘grassland’ or ‘bushland’ (Acacia), with approximately 100 in each category. The high number of sites located within Acacia bushland areas seems an aberration, since pastoralists depend on the fluctuating conditions of grassland, not
bushland, for their survival. It also suggests that the environment at Laikipia may have been different in the past, with more grassland regions once surrounding pastoralist settlements. Recent paleoenvironmental research conducted under the auspices of the project certainly indicate that the vegetation of the Laikipia Plateau has changed several times during the later Holocene, and on occasion perhaps directly as a result of the intensification of pastoral activity (Taylor et al. 2005). This is also the impression gained from the reports given by Laikipia’s first European visitors. For instance, Stigand referred to “great open plains” with “gently undulating downs of short grass” (Stigand 1910), and rather similar descriptions appear in the accounts given by von Höhnel (1894) and Patterson (1910 [1974]). A detailed study using ‘matched photography’ conducted on Lolldaiga as part of this project also seems to bear this out; with the evidence suggesting that since the 1930s many of the large glades (open areas of mixed grassland within a surrounding cover of bush and Acacia scrub) on Lolldaiga have been steadily encroached by Acacia bush. This said, a sampling bias may have contributed toward the observed pattern of proportionately equal numbers of sites within bushland and grassland environments, as artifacts are not so easily spotted in high grass, and so the actual density of artifacts in such locations may be under-represented. But this alone cannot explain the high number of sites found within bushland. Also, besides a possible encroachment of Acacia deduced from the vegetation maps, aerial photographs of Mugie Ranch show possible landscape modification induced by pastoralism - namely, the formation of large glades.

Future Research at Laikipia

Future research at Laikipia will focus on Lolldaiga and Mugie Ranches and build on the discoveries of the BIEA interdisciplinary project. It will target a region of unexplored bushland in the northwestern corner of Lolldaiga to see if archaeological sites may be present (Figure 2). GIS cost-surface and visibility algorithms (based on topography) have suggested that the large area of bushland in northern Lolldaiga would have been easily accessed by pastoralists, so one would expect that pastoralists roamed this part of the landscape and may have left material evidence behind (Causey 2005). If a high number of pastoralist sites are indeed scattered across this region, then the difficult task becomes discerning whether pastoralism was the cause of the encroachment, as it is also possible that this profusion of Acacia could be due to more natural global or local fluctuations in climate completely unrelated to pastoralism. Or, it could be also due to changes in grazing regimes and stock densities when this area was acquired for commercial ranching in the 1940s, or to a combination of these factors. Oral histories concerning the use of the ranch and written records will help determine how grazing regimes and stocking levels adopted under a system of commercial management compared with those employed by earlier pastoralists under a system of common property rights, and, when and if bushland intruded after these changes were introduced. A close inspection of the vegetation types in the field may reveal if grassland is found in and around the bushland areas, while soil sampling may resolve whether this part of Lolldaiga Ranch is capable of supporting grassland or perhaps even woodland (Figure 2).

Certain pastoralist activities may produce salutary effects on the landscape, such as a prevention of bushland encroachment. It is well known among archaeologists who work in the region, for instance, that large, open glades within areas of bushland often contain scatters of archaeological materials. Recent ecological studies of such glades, including examples on Laikipia (Augustine 2003; Young et al. 1995), have also shown that many originated as areas of pastoralist settlement. Numerous glades sprinkle the landscape on Mugie and need to be ground-truthed to evaluate and ascertain the specific behaviors associated with them. Several of those investigated do indeed contain archaeological traces of pastoralist activity, although this was not always the case. Future surveys will aim to enlarge the sample of ground-truthed glades. However, instead of plotting sites as single points in GIS - a common oversimplification in GIS spatial analysis - individual and contiguous artifacts will be geo-referenced within the landscape, so that particular activities may be related to environmental variables (Lock 2003).

In an effort to demonstrate the value of this approach, a pilot project was carried out on Mugie Ranch during the summer of 2005. After visiting several glades in the field, it became clear that many possess a great degree of internal complexity so that the spatial dynamics are not so easily defined. Specifically, there are often various vegetation patterns
Figure 2. A key question that needs to be answered in future archaeological investigations of the Laikipia Plateau is whether pastoralism causes or prevents an encroachment of bushland. The massive area of *Acacia* in northern Lolldaiga Ranch will be inspected for behaviors that may contribute toward the apparent proliferation.
Figure 3. This aerial photograph of Mugie Ranch shows a 250 m² area that was surveyed as part of a pilot project carried out in 2005. The field season discovered a close spatial relationship between low ‘ash’ mounds and highly barren areas.
such as blotches of barren areas; patches of enriched taller grass; *Acacia* bushland; and yet other areas of attenuated grass, suggesting that a number of different activities occurred within the glades. Therefore, GIS modeling may be the best approach to understand the spatial dynamics of the glades and how they relate to specific pastoralist activities, distributions of soil nutrients, and various natural processes such as differential grazing by herbivores. During the pilot project, basic vegetation maps were generated in the field, using allocation criteria as suggested by van Leusen (1993), where vegetation types were broken down into three simple categories in 12.5 m² blocks of a larger 250 m² surveyed area. These are barren, grass, and bush. A direct correlation was found between relatively barren areas devoid of or containing shorter grass and a series of mounds (Figure 3). As many of the materials on the surface and within the mounds seemed burnt, these may have served as refuse middens when pastoralists occupied the region. And because nearly all the mounds lack significant vegetation cover such as dense grassland, these features may deprive the landscape of the necessary cover to support those species of African wildlife that prefer bushy habitats. Conversely, the glades typically encourage the proliferation of grazing herbivores, which through their attraction to the glades help sustain these areas of grassland long after they have been abandoned by pastoralists. How long such features can remain in the landscape, and the degree to which they foster biodiversity remains unclear, however, and future studies pinpointing the different human and natural processes associated with the various vegetation patterns are required. A start on this has already been made on Mugie, where highly accurate and meticulous EDM surveys have been carried out. These will be converted to localized DEMS, so as to allow vegetation, topographic, artifact, feature, and possibly soil coverage to be spatially analyzed in GIS - a component of GIS spatial analysis that is imperative but often lacking in archaeological studies, especially those that attempt to understand taphonomic processes (Kvamme 1990). Once these and related studies have been completed, it is hoped that the combination of GIS and landscape archaeology will illuminate some of the possible long-term environmental consequences of pastoralism and equip policy-makers with the information they need to protect East African wildlife better, as well as pastoral rangelands.

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