An historical note from Tsavo East National Park: vegetation changes over time

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Introduction

This largely personal memoir is about vegetation changes reported or observed in a part of Kenya's Tsavo East National Park (the Aruba block) between 1950 and 2017. They cover conversions from evergreen thicket impervious to fire, through *Commiphora/Acacia* woodland to fire-prone grassland and eventually temporary desert. Their proximate cause was rising elephant numbers from natural increase, dispossession of range by hunting pressures outside the park and inducement by providing permanent water where none had existed before. Drought exacerbated this instability and in 1971 thousands of elephants and other wild animals died of starvation. A wave of poaching in the aftermath of drought further depleted elephants so that by 1978 the combined mortality was about 80% of 1968 numbers. By 1992, in the wake of this substantial decline and despite some occasional fires, the vegetation in parts, but not all of Tsavo East was regenerating woodland. This regeneration has not happened where there has been large scale illegal grazing by cattle. The degree to which this is responsible for the current state of the vegetation is not known, but likely to be considerable. Similarities between elephant-induced events in Uganda are noted and the philosophical implications for the received purpose of national parks commented upon.

The Historical Notes

This condensed description of vegetation change in a section of Kenya's Tsavo East National Park (TENP) covers the period 1950-2017. The part referred to as the Aruba block, is bounded in the north by the Sabaki River, in the east by the Park boundary, in the south by the Nairobi-Mombasa railway and in the west by the road between park headquarters at Voi and the causeway across the Sabaki above Lugard's Falls (Fig. 1). It encloses the tip of an arid climatic peninsula protruding down from the north in which rainfall is commonly around or below 250 mm annually. In 1950, much of the vegetation was *Commiphora/Acacia/Sansevieria* thicket so dense, that it limited visibility on the ground to < 50 m, only broken by open grassland on 'black cotton' soils and within a limited distance of the Sabaki River. This vegetation was in many places so thick that game viewing, the aim of most visitors, was greatly restricted. To make fauna more visible, the Park staff tried to open it up

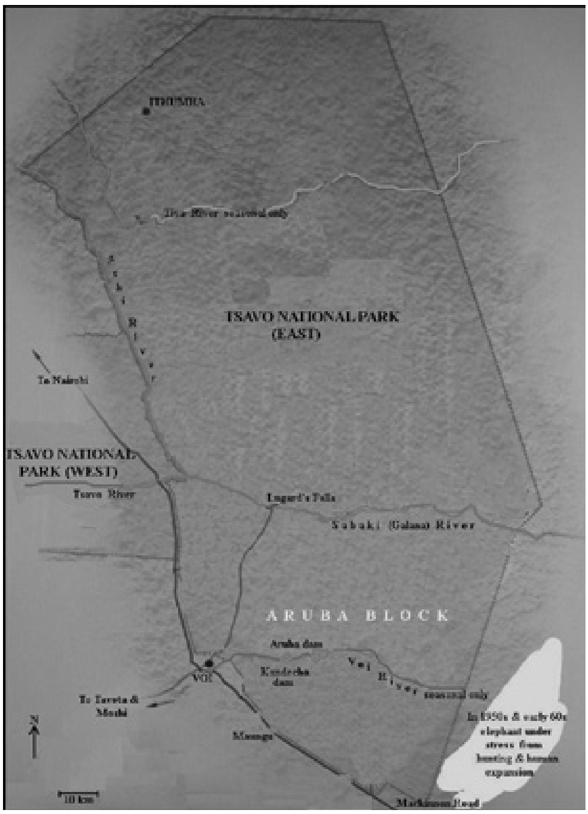

Figure 1. A diagram of the section of the Aruba Block in TNEP described in the text.

with fire, but they failed. The dense thicket with its understory of evergreen *Sansevieria* would not burn (pers. coms. Sheldrick in 1958, Lawrence in 1962, and Woodley in 1990, all of whom described this independently) and further attempts were abandoned.

In the east of the Park, but principally south of the Voi River course, where rainfall was slightly higher and the vegetation so dense that it hosted forest animals—red duiker (*Cephalophus harveyi*), bushbuck (*Tragelaphus scriptus*) and crested guinea fowl (*Guttera purcherani*)—unexpectedly in such low rainfall. This very thick vegetation in the vicinity of Garbete and Debaso hillock accommodated many elephants which usually concentrated in one or several very big, compact herds characteristic of elephants under duress (Laws et al. 1975). At the time they were being hunted heavily by Wata bow men (Holman 1978, Ville 1995, Ville and Guyo 2004), and increasingly disturbed by widespread charcoal burning that was a rising activity throughout this habitat. Further, when seasonal sources had dried up, elephants had to compete with people for water at the very few deep rock pools (e.g. Rei and Mido), pools in the Voi River course, or use the Sabaki River, 35 km away to the north. Wata informants familiar with these elephants noted that in the wet season when water was not limiting, they moved west into the Aruba block of TENP (Parker unpublished records).

The Tsavo National Park was promulgated in 1948, and immediately offered some protection from the hunting then taking place. By 1955, two dams—Aruba and Kandecha—had been built across the Voi River course to provide permanent water for wildlife where none had previously existed. In the same era on the south edge but just outside the Park border at Maungu (Fig. 1), break-pressure tanks on the Mzima-Mombasa water pipeline started providing constant overflows of which TENP elephants took advantage.

These new water sources, in and on the border of a protected area, induced elephants to remain in what had until then been only wet weather range. By 1963, the very large herd(s) that had been such a feature around Garbete and Debaso outside the park, were no longer being reported (Parker unpublished records) and presumed to be now staying year-round in TENP's Aruba block. In 1957 Sheldrick (pers. com.) noted elephant-smashed woodland near Aruba dam, and opining the likely cause was the permanent water inducing them to stay where previously they only visited seasonally. The consequence of intrinsic natural increase (Laws 1969), displacement from outside TENP by hunting pressures and permanent rather than seasonal residence made possible by the presence of constant water, was rising elephant density in the Aruba block.

Between 1950 and 1963 elephants had opened up hitherto dense vegetation, not only in the area specifically referred to, but across TENP generally. Occasional fires migrating across country from outside the park were now causing concern (Glover J. 1963; Glover PE. 1968). Exacerbated by drought, in 1971 the trends culminated in a vegetation collapse mirrored in an elephant population crash, when thousands died (many other animals including black rhino perished too).

While starvation in 1971 may have accounted for approximately 15,000 elephant deaths, they were followed by a wave of poaching (Sheldrick 1976, and deduced from ivory imports to the Far East—Parker unpublished data). The decline from c. 40,000 (Laws 2017) to c. 8,000, i.e. 80% recalls the collapse of elephant numbers in Uganda (Parker 2017). In TENP outside the Aruba block, this reduction of elephants was followed by vegetation recovery. By 1980, the surrounding environment was widely covered with a heterogeneous carpet of grasses, forbs and saplings that by 1992 could in places be classified as re-emergent parkland or open woodland (Figure 2; see colour plates: page vi). Although in a different biome, the rapidity with which the components of woodland re-established themselves in TENP repeated the pattern in Uganda in and around Murchison Falls National Park (Parker 2018), albeit at a somewhat slower rate, which is understandable given the lower TENP rainfall.

Inside the Aruba block, however, the 1971-1975 culminate state was c. 1,000 km^2 of largely bare earth (Figures 3 and 4; see colour plates: page vi), which had not recovered as woodland by 2017. Though drought has struck again several times in the intervening years since 1971, the photograph (Figure 5; see colour plates: page vi) taken on the Aruba block's southern border at approximately the same time as Figs 3 and 4, had shared the block's climatic regime and soils. The difference between the two photographs—Figs 3 and 5—is that where elephant were absent from the latter, trees survived despite drought and a light human presence.

Within the TENP Aruba block, over the decades

1990-2017 Somalis and Orma from the north and Maasai from the south have pastured thousands of cattle in it (and in the park north of the Sabaki as well). The presence of these cattlemen, stock and attendant influences such as starting fires, have added to pressure from those elephants still using the area. Their relative responsibilities, independently or jointly, for the lack of diversity are unclear, but the results are best seen on images from Google Earth. Three illustrations sum evidence. Figure 6 (See colour plates: page vi) is of Aruba Lodge whose precincts were fortified with a ditch and fence to keep large mammals out. Albeit not necessarily representing what could have happened outside the protection, tree growth within it is proof nonetheless of what is possible with the area's soils and in its climate. Beyond the ditch the lack of plant diversity is self-evident.

Figure 7 (See colour plates: page vi) is the Aruba block's southern border in the vicinity of Maungu. The railways and the main road divide the park to their north from the ranches that lie to their south. In the block, woodland that was cleared by elephants by 1971 never recovered. South of the divide on privately owned group ranches, *Commiphora* woodland survives because neither elephants nor the uncontrolled pastoralists have had access to it. With the same climate and soils in both places their distinctly different vegetation reflect presence/absence of elephants in recent history.

Fig. 8 illustrates TENP's southern border outside the Aruba block between Voi and Ndii Hill in 1974. Repeating Fig. 7 there is treelessness on the park side to the north, induced by elephants, wooded to the south where elephant seldom ventured and people were present. Figure 9 (See colour plates: page vi) is a Google Earth view of the same area as Fig. 8 in 2017 where Taita farmers have replaced the woodland with cultivated space. Further west the park border is just as starkly delineated by cultivation by Akamba farmers. These reflect the same phenomenon in Uganda where national park borders are demarcated by tilled land as shown in Parker (2018).

What took place in well watered and equable Uganda (Parker 2018) was repeated in semi-arid, drought prone, arid Tsavo. Vegetation of different types at one time impervious to fire were opened up by elephants, facilitating flammable grasses to expand and with them fire to become a feature in the biomes. In Uganda the malnutrition that coincided with the loss of forest and woodland initiated a protracted decline in elephant numbers over at least two decades (Laws et al. 1975). The different exigencies of semi-arid Tsavo resulted in a population crash. Both situations presented evidence that some vegetation complexes are fireproof, and that in the absence of people or elephant or both, grassland can revert toward those states. Both showed fast woodland recovery despite fire, though fire may slow down the process.

This history presents no novel principle. It is also likely that while the events described may be unique in detail, it is likely they were recurrent features of history. Gillson (2002) presented evidence from pollen data, stable isotopes and charcoal abundance

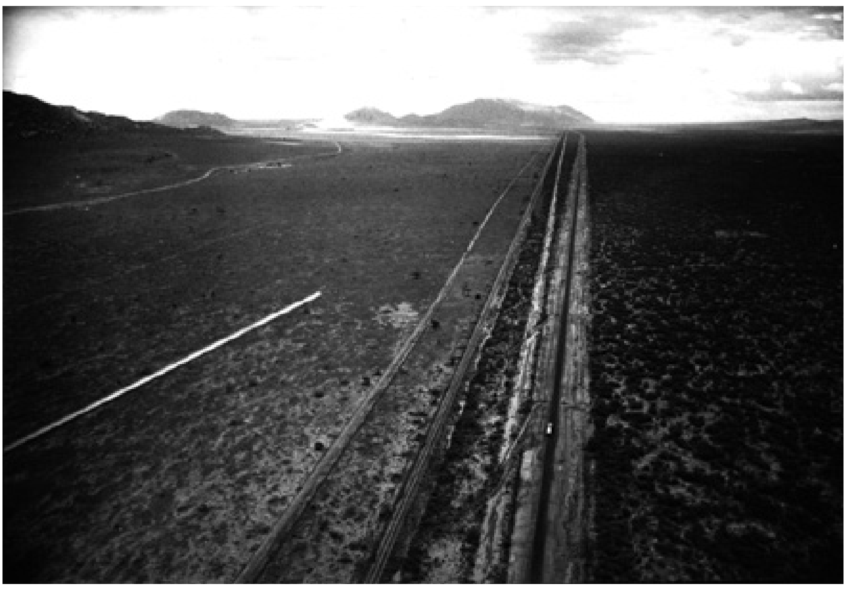

Figure 8. Looking horizontally south down the Tsavo East border towards Sagalla Mt between Ndii Hill and Voi in 1974. Park cleared of trees by elephants on the left of the road/rail lines; Commiphora woodland where the elephants did not venture on the right but people were present. Ten years earlier the same woodland existed on both sides of the lines (photo P. Beard).

indicating that over the past 1,500 years change has been a feature of TENP's vegetation. Graves and oral history confirm that the area's vegetation in the 18th century had been sufficiently open to permit Orma and their cattle culture to flourish there. At other times, as in 1950, tree density harboured the tsetse *Glossina longipennis* (La Roux pers. com., Glover PE pers. com.) that would then have rendered it uninhabitable by cattle. However while Gillson's results do not establish exactly how past vegetation changes she records came about, and the frequency of lightning fires past and present is unrecorded, it is reasonable to assume from the past century's evidence that elephants, people and fire will have been involved.

While fire has been secondary in the gross vegetation changes in Uganda and Tsavo here reported, it featured in the planet biology longer than either elephants or humans have existed. Two ancient examples of its influence are the thick corky barks of many trees evolved to withstand flames, *Terminalia glaucescens* among them, and the eggs of Temminck's courser *Cursorious temminckii* whose crypsis lies in mimicking antelope droppings sprinkled with grass ash. Fire's stochastic appearances may elevate it to primary roles in shaping vegetation at least occasionally. Such an event happened in 1961 on the Galana Ranch along TENP's eastern border. Cyclonic rainfall of 450 mm in a day where annual expectation was < 500 mm, was followed by prolonged and heavy seasonal rains. Grasses that seldom exceeded knee height after a good season grew to 3 m (Fig. 10) engulfing the low *Commiphora* and *Acacia* trees typical of the area. In due course the grasses dried and were accidentally set alight before strong winds. Within a week it had burned > 1,000 km^2 killing the majority of trees that would have survived fire in grass < 1 m high. In this case the unusual rain of 1961 facilitated a single fire that locally outweighed elephant and human influences for years to come.

Elephant influences may not have reached such extremes as occurred in Uganda or in the area of TENP described. Yet other African national parks—Serengeti, Luangwa North and South, Sengwa, Hwange, and Kruger to name but few–have all reported elephant habitat modifications. Dudley 2017 and van Staden et al. 2017 recently remake the point. When most national parks were established, mainly after the Second World War, legislators and conservation authorities did not appreciate the significance of elephant habitat modification, namely how integral it is to being an elephant, and were taken by surprise. Yet while the phenomenon may not have been quite so striking as change induced by elephants, Laws (2017) and his colleagues showed that hippo (*Hippopotamus amphibious*) also profoundly influenced habitats within an obligatory distance from water. The two examples illustrate an ecological fluidity that denies stasis or self-regulating balances within ecology. Ongoing competitive exclusions and/or facilitations between both plants and animals (Mayr 1965) is more likely the norm and that it has not been reported more widely between species in African parks may be more the outcome of not having been noticed, than not occurring.

Figure 10. After the cyclonic rain of 1961 in the Galana Scheme, grass that would normally have been knee height grew to over 2 m and when it burned in 1962, it killed all *Commiphora* and *Acacia* trees that would have withstood fire in the normally far shorter grasses.

TENP in Kenya and Murchison Falls National

Park in Uganda were established to preserve the biota within them when they were created. The vegetation changes that have occurred therein are proof that neither achieved their original objectives and biodiversity in 2017 is different to what it had been when they were established. Elephants have been central in bringing this about. Yet while destroying woodland focussed attention, a more far-reaching, if less appreciated, consequence is what the changes portend for the generally received purpose of national parks. Is preserving biota *in perpetuo* as they were at a given point or period in time possible? That, surely, is the fundamental issue emerging from elephant induced vegetation changes in national parks?

Acknowledgements

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