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Saving the Great Migrations: Declining wildebeest in East Africa?

The iconic wildebeest migrations of East Africa are an important ecological phenomenon and massive tourist attraction. However, many wildebeest populations are in drastic decline across the region (Estes and East, 2009). Their dispersal areas and migratory corridors are being lost due to high human population densities, increasing urbanisation, expanding agriculture and fences. Their loss would contribute to biodiversity decline, and jeopardise tourism and other ecosystem services. Urgent efforts need to be made to protect wildebeest migratory corridors and dispersal areas to ensure these great migrations for the future.

Why is this issue important?

Large scale animal migrations were once common around the world, but many have now collapsed, and others face serious decline (Bolger et al., 2008; Harris et al., 2009). For example, on the Great Plains of North America, the American bison once numbered as many as 30 million animals; today only few remnants remain due to over- hunting (Bolger et al., 2008). In Central Asia, the Saiga antelope has declined from over 1 million animals in 1980 to less than 200,000 in 2000 (Milner-Gulland et al., 2001). In Kenya, the migration of vast herds of zebra and Thomson's gazelle between the Lake Nakuru-Elementaita region and the Lake Baringo disappeared in the early part of the 20th century due to over-hunting, habitat loss and other human disturbances (Ogutu et al., 2012).

The East African savannas are well known for the large-scale seasonal migrations of grazing herbivores. Perhaps one of the most well-known is the annual migration of 1.3 million wildebeest, 0.6 million zebras and Thomson's gazelle in the Serengeti-Mara ecosystem (Sinclair, 1995). The significance of this migration is huge: it is the largest and most species diverse large mammal migration in the world. It is of iconic importance for tourism and has huge ecological significance, resulting in the Serengeti National Park in Tanzania being listed as a World Heritage Site (UNESCO, 2013).

The East African savannas are highly variable ecosystems, so migration enables animals to track spatially and temporally varying resources across the landscape. This gives migratory populations an advantage over resident populations, and allows these populations to rise to very high abundances (Hopcraft et al., 2013). Migrants may also move to access breeding grounds, to reduce the risks of predation and disease, and to enhance their genetic health (Bolger et al., 2008).

Wildebeest migrations are important both ecologically and economically. They play a vital role in ecosystem function and provide a number of important ecosystem services. They also have a direct effect on predator populations and other wildlife species, and on grass food resources (Sinclair et al., 2008). Economically, wildebeest migrations are important because they draw in tourism and thus contribute significantly to national economies. Tourism generated an estimated US$1.2 billion revenue in Kenya in 2012 and US$1.3 billion in Tanzania in 2011 (KNBS, 2013; RoT, 2011). In Tanzania, the northern safari circuit alone, the main attraction of which is the Serengeti-Mara wildebeest migration, generated an estimated US$550 million in 2008 (Mitchell et al., 2009). Any loss of wildlife migrations, or their habitats, could undermine some of East Africa's key tourism products with significant impacts on national economies.

What are the findings?

Declining wildebeest in East Africa

Wildebeest depend on migratory corridors and dispersal areas as they migrate out of protected areas to their seasonal habitats, often located in pastoral lands. Migratory corridors and dispersal areas usually cross human-dominated landscapes where land use practices are becoming increasingly incompatible with wildlife. As these areas are degraded or lost, severe declines in the wildebeest populations can result.

In East Africa, the white-bearded wildebeest, found across Kenya and Tanzania as shown on Figure 1, is facing large declines due to incompatible land uses in their migratory corridors and dispersal areas (Estes and East, 2009). This has occurred as their migratory corridors and dispersal areas have become blocked or lost, limiting their migratory movements. The result has been the near collapse of many wildebeest populations. The exception to this general pattern is the Serengeti-Mara population, which increased six fold between 1963 and 1977 following the eradication of rinderpest, before stabilizing at its current population of approximately 1.3 million (Hopcraft et al., 2013). In southern Africa, the blue wildebeest is stable or increasing; although their numbers are still far lower than their 1960s levels (Estes and East, 2009).

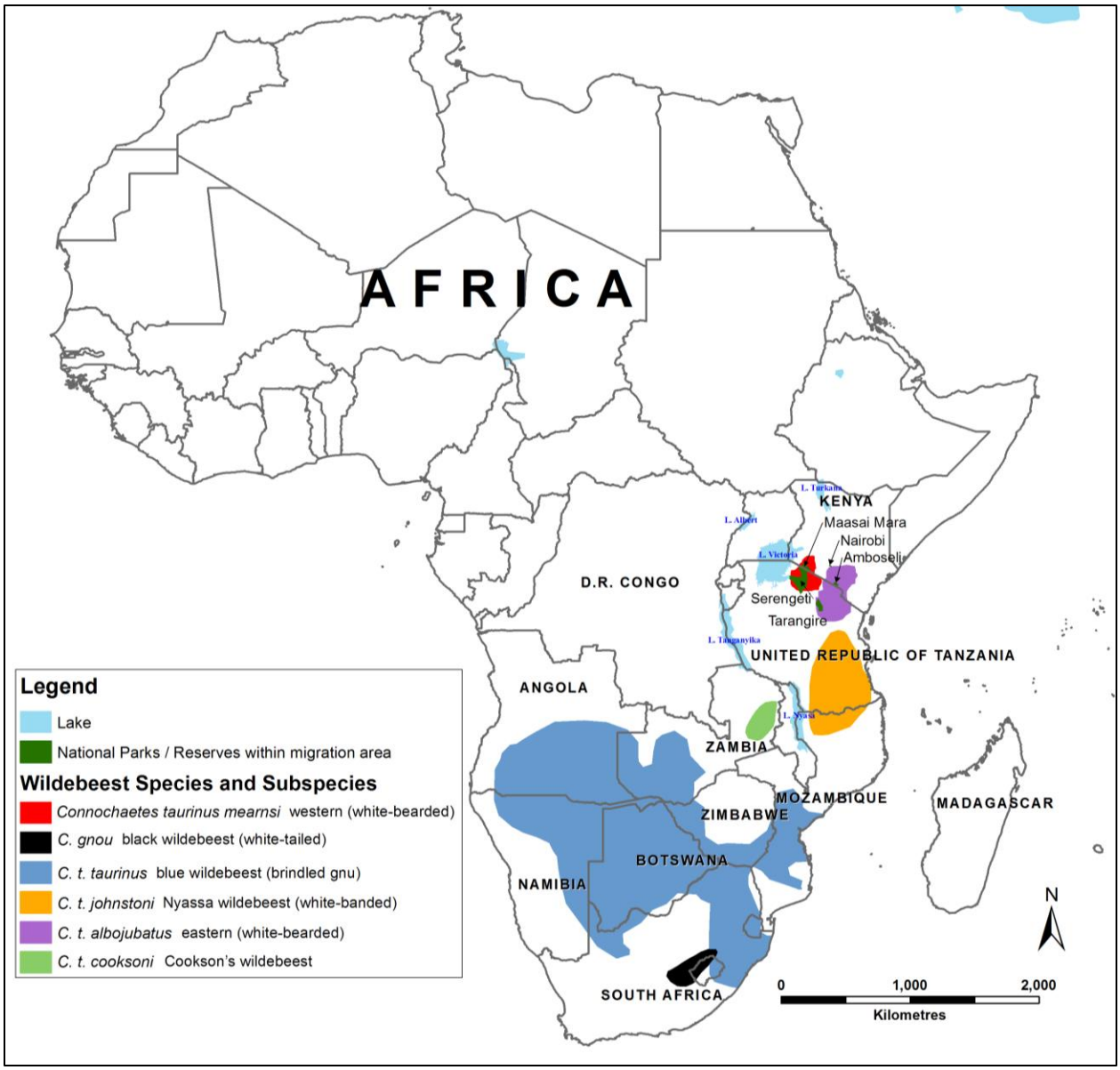


Figure 1. Map showing the distribution of wildebeest subspecies in Africa including some important National Parks and Reserves in Kenya and Tanzania. Source: (Estes, 2006), visualisation by UNEP/DEWA.

In Kenya, all four wildebeest populations are declining dramatically as indicated by the latest trends (Figure 2). In particular, in the Mara ecosystem, found within Narok County, the wildebeest population that migrates annually between the Maasai Mara National Reserve and the Loita Plains declined by more than two-thirds, from approximately 113,000 in 1977 to 35,000 by 2009 due to the expansion of agriculture (Ogutu et al., 2011) and continues to decline to date. In the Athi-Kaputiei ecosystem, the wildebeest migration between the Nairobi National Park and the adjoining Athi-Kaputiei Plains declined by more than 90%, from over 30,000 in 1978 to under 2,000 by 2011 as a result of increasing urbanisation, fencing, settlements, mining and other developments (Ogutu et al., 2013).

In Tanzania, in the Tarangire-Simanjiro ecosystem, the wildebeest migration from Tarangire National Park to the Simanjiro Plains declined by 88%, from 43,000 in 1988 to 5,000 in 2001 due to expanding cultivation and settlements blocking their migratory corridors (Bolger et al., 2008; Msoffe et al., 2011).

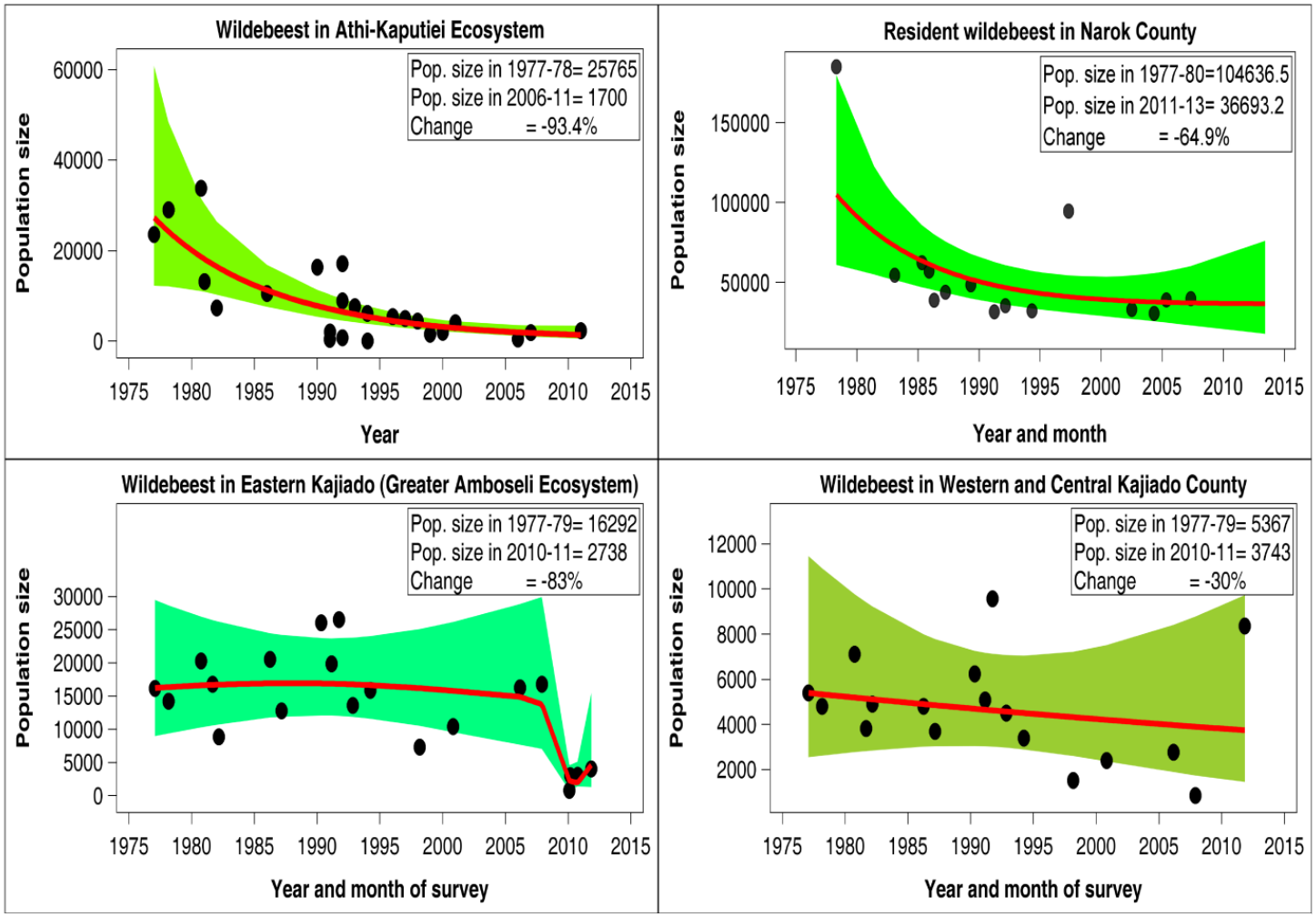


Figure 2. Trends in wildebeest populations in four regions of Kenya. Black dots are population estimate from aerial surveys, the red lines are the fitted trend curves, and the shaded bands are the 95% confidence bands. (Figure courtesy of Joseph O. Ogutu, data drawn from Ogutu et al., 2013; Ogutu et al., submitted).

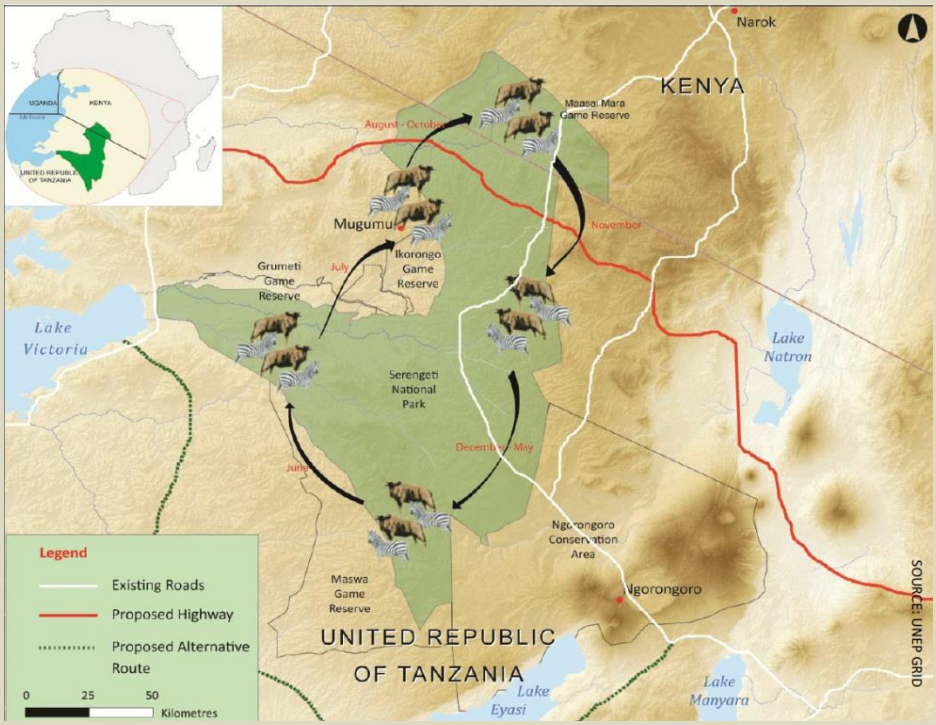
In each of these cases, wildebeest are prevented from accessing their wet season ranges due to the blockage of migratory corridors or the loss of habitat in their dispersal areas. Wildebeest are especially vulnerable to human impacts in their wet season ranges. Many protected areas in East Africa primarily conserve the dry season habitat for migratory wildlife, with the wet season ranges occurring almost entirely outside of protected areas on adjacent communal or private lands (Fynn and Bonyongo, 2011). Protected areas also tend to be small and were not designed to conserve all of a migratory species' habitat requirements (Fynn and Bonyongo, 2011). As a result, wildebeest must journey outside of protected areas to reach their wet season ranges. Here they face a number of pressures due to human population growth, land use change and increasing development.

In the past, protected areas were able to sustain large migratory wildebeest populations because human population densities were low enough to allow them to migrate outside of protected areas to their wet season ranges. However, this is becoming increasingly difficult as human populations surrounding protected areas rise, and land use changes and habitat loss intensify. Today, nearly all the world's remaining large wildlife populations exist in unfragmented migratory systems (Fynn and Bonyongo, 2011). For example, the Serengeti-Mara ecosystem migration has been sustained because it has survived in a relatively intact ecosystem contained within a network of protected areas that encompass all the grazing habitats required to

support a large migratory population. However, this migration too now faces a number of threats (see Box 1).

Box 1. Road and other threats to Serengeti-Mara wildebeest migration

The government of Tanzania plans to build a road across 50 km of the northern part of the Serengeti National Park to link the coast to Lake Victoria and other inland countries. The environmental impact assessment predicted that by 2015, 800 vehicles per day would cross the road and by 2035, this would rise to 3000, an average of one every 30 seconds (RoT, 2010).



Map of the Serengeti-Mara ecosystem, showing the route of the migration, and the position of the proposed road and the alternative southern route. Source: UNEP/GRID

There are concerns over the road's impact on the migrating animals which cross the path of the road on their way to Kenya and back (Dobson et al., 2010). Holdo et al., (2011) estimate that the road could lead to a 35% loss in migrating wildebeest due to the effect of habitat fragmentation. Moreover, these effects could be magnified by incoming fences, development and vehicle collisions (Dobson et al., 2010). There are also concerns of the wider implications of the road, not just its impact on wildebeest numbers because the migration plays an important role in a number of ecosystem processes which could have knock-on effects on other flora and fauna (Holdo et al., 2011).

From a development point of view, the importance of the road for socio-economic development in the area is emphasized, as is the need to consider local people and their livelihoods as key components of the ecosystem (Fyumagwa et al., 2013; Homewood et al., 2010). The lack of a developed road system can exacerbate poverty amongst local communities, leading to illegal or ecologically destructive activities, such a poaching, due to the lack of alternative livelihood options (Fyumagwa et al., 2013). The road should be viewed from a broader perspective of the threats facing the Serengeti-Mara ecosystem and its migration, along with agricultural intensification, destruction of the Mau Forest catchment area of the Mara River, and climate change (Fyumagwa et al., 2013; Hopcraft et al., 2013).

Alternative solutions to the road have been suggested, including a southern route that bypasses the Serengeti altogether (Dobson et al., 2010; FZS, 2010), or an elevated highway allowing animals to cross underneath (Main, 2013). However, despite initial news that the road project would be cancelled (Hance, 2011a), the Tanzanian government confirmed in mid-2011 that the road construction would go ahead, but as an unpaved road (Hance, 2011b), although construction is yet to start.

Threats to wildebeest migrations

The **loss or fragmentation of habitats** is one of the main threats to wildlife migrations globally (Bolger et al., 2008; Harris et al., 2009). In East Africa, wildebeest migrations are in decline due to a number of land use activities causing habitat loss and fragmentation in their wet season dispersal areas. These land use activities, which include cultivation, land subdivision, settlements, fencing and other infrastructure, disrupt migratory movements and cause wildebeest populations to decline.

Kitengela development

Fences obstruct migratory routes and have deleterious impacts on wildlife populations (Bolger et al., 2008; Harris et al., 2009). Fences are used to stop resource competition and disease transmission between wildlife and livestock, to prevent poaching and to protect crops and homes. Fencing is one of the main causes of the crash in the wildebeest population in the Athi-Kaputiei ecosystem in Kenya, blocking and threatening migratory routes (Ogutu et al., 2013). More than 20% of the ecosystem is now fenced, and a number of migratory corridors linking the Nairobi National Park and the Athi-Kaputiei Plains have been blocked by fences (MEMR, 2012) (Figure 3). Now, only few wildebeest enter Nairobi National Park during the dry season (Ogutu et al., 2013). Similarly, fencing, cultivation and other developments now threaten the wildebeest migrations in the Amboseli ecosystem and the Mara-Loita Plains (MEMR, 2012).

Roads obstruct migratory routes, cause wildlife mortality due to vehicle collisions, and decrease landscape connectivity (Lesbarrères and Fahrig, 2012). Due to increased access, roads can also open up new areas for development, leading to land uses incompatible with wildlife. These are many of the concerns in the

development of a new road through the Serengeti National Park (see Box 1). In Kenya, a similar threat faces the wildebeest migration in the Athi-Kaputiei ecosystem due to the upgrading of the Athi River-Namanga Road and the proposed Greater Southern Bypass Road along the southern boundary of Nairobi National Park (FoNNAP, 2011).

Poaching is a threat to many migratory populations, particularly as human populations around protected areas increase (Bolger et al., 2008; Harris et al., 2009). In the Serengeti National Park it is estimated that local consumption of bushmeat is responsible for approximately 70,000-129,000 wildebeest deaths per year (Rentsch and Packer, 2012). A high intensity of poaching is also linked to a decline in wildlife numbers in the Mara area of Kenya (Ogutu et al., 2009). Any further increase in the amount of poaching in the Serengeti-Mara ecosystem could lead to declines in the wildebeest population (Hopcraft et al., 2013).

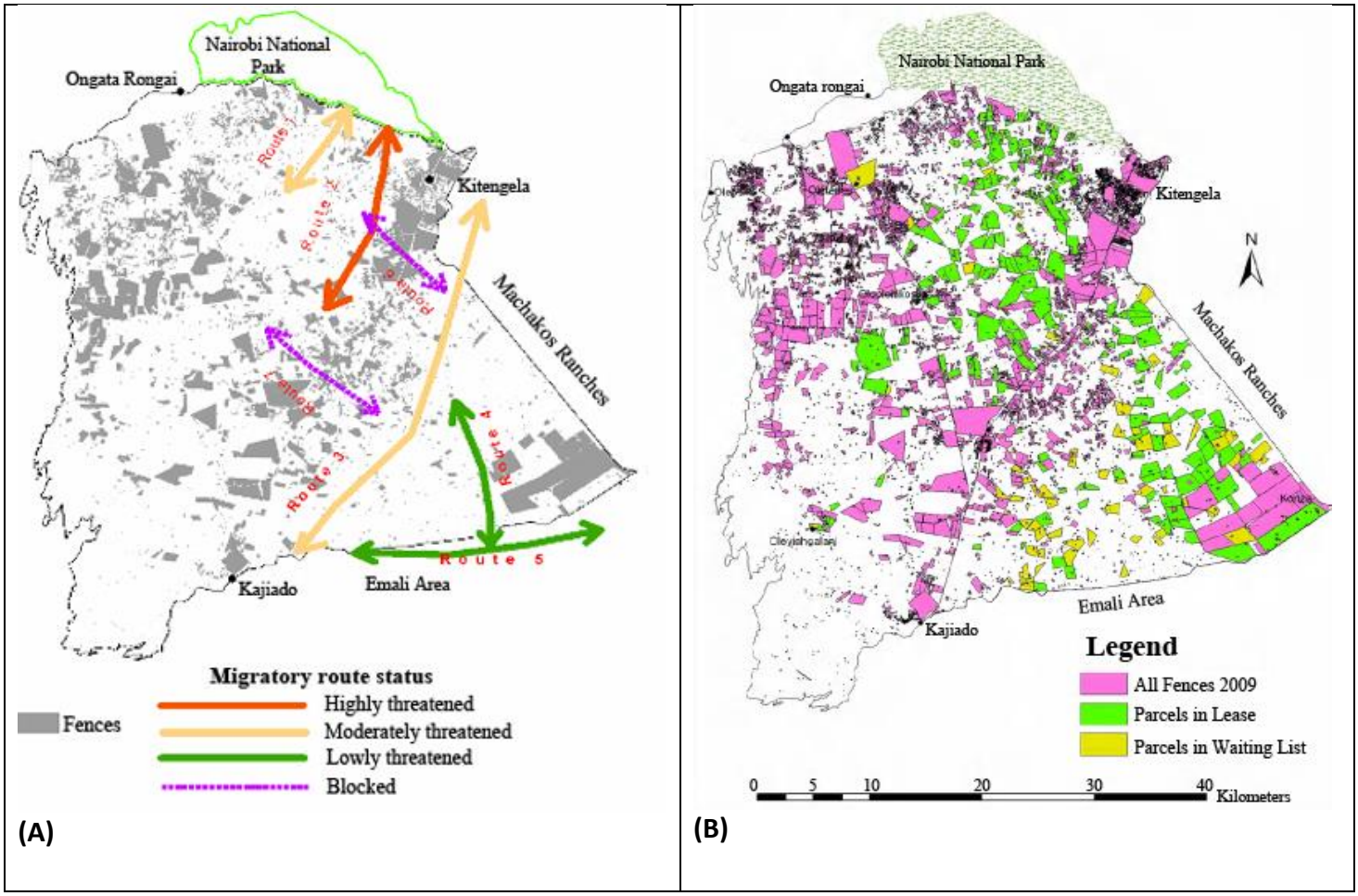


Figure 3. (A) Map showing the position of fences blocking wildlife migratory routes to and from the Nairobi National Park of the Athi-Kaputiei ecosystem in Kenya, and (B) initially fenced land parcels now signed up to the wildlife lease program prohibiting fencing (from MEMR, 2012).

Climate change is a new and growing threat to wildlife migrations in the East African savannas. The increased frequency and severity of droughts and floods that is expected to occur (IPCC, 2012) will modify vegetation growth and hence food availability for the migrating animals. In the Amboseli ecosystem, a severe drought caused the wildebeest population to crash by more than 85% in 2009 (MEMR, 2012). By 2010, the population numbered only 3,000 animals, down from over 15,000 animals before the drought, the lowest observed for more than 30 years (MEMR, 2012; Ogutu et al., submitted; Figure 2).

The ability of migrants to respond to changing climatic conditions is likely to be impaired by such man-made threats as habitat loss and fragmentation. As migratory corridors and dispersal areas are lost due to land use change, this will curtail migratory movements and compromise the ability of migrants to cope with the widening climatic variability expected as a consequence of global warming (Owen-Smith and Ogutu, 2012). In the Athi-Kaputiei ecosystem, Ogutu et al. (2013) show how compounding of the effects of human development with those of widened annual rainfall variation threatens wildlife populations.

What is being done?

Since most migrants wander outside of protected areas, it is crucial to include communities and landowners in conservation efforts through participation in wildlife management and benefit-sharing. In the East African rangelands, economic benefit to local communities from wildlife has been meagre (Homewood et al., 2009) with little incentive to help protect migrants or their dispersal areas and migratory corridors.

Efforts are now being made to secure wildlife dispersal areas and migratory corridors through the use of community conservancies, payments for ecosystem services and other economic incentives. For example, in the Mara, eight wildlife conservancies have been formed, which offer land lease payments of US$25-40 per hectare (ha) per year to landowners (Bedelian, 2012). These schemes, financed by ecotourism operators, aim to keep land open for wildlife and provide landowners with a regular income stream. They now cover over 90,000 ha, securing vital migratory corridors and dispersal areas for wildebeest from both the Serengeti and the Loita Plains (MEMR, 2012).

In the Athi-Kaputiei ecosystem, the wildlife conservation lease programme, supported by a number of donors, offers participating landowners US$10 per hectare per year to keep their land open for wildlife and livestock in the wildebeest dispersal area. This programme is being targeted to secure wildlife migratory corridors and critically reduce fencing in this ecosystem and by 2012 covered 24,200 ha (Figure 3) (MEMR, 2012; Ogutu et al., 2013). In another approach, environmental easements are being applied to protect privately owned land adjacent to Nairobi National Park, including placing it under park management (Watson et al., 2010; USAID, 2013). Also in this ecosystem, the community and other stakeholders have recently developed the first community driven land use master plan to sustainably manage wildlife dispersal areas alongside livestock grazing, settlements and other land uses in the ecosystem (Nkedianye et al., 2009). In the Tarangire-Simanjiro ecosystem in Tanzania, payments for ecosystem services, financed by tour operators, are being used to protect the dispersal area of migratory wildebeest and other wildlife in the Simanjiro plains (Nelson et al., 2010).

What are the implications for policy?

Conserving migratory routes requires implementing conservation plans beyond protected area boundaries. Dispersal areas and migratory corridors can be kept open for wildlife, by encouraging wildlife-friendly land uses, and the cooperation and participation of community and private landowners. Governments need to provide the correct enabling policy and legislative environment to support the types of initiatives already emerging to protect migratory habitat. Due to the trans-boundary nature of wildebeest migration in East Africa, the respective countries and governments need to work together to mitigate threats to the migrations.

Good scientific information on where, when and why wildlife migrations occur is needed to inform conservation and management decisions. This includes mapping the movements and ranges of wildebeest, the ecological drivers of migration, population levels, and a good understanding of the threats to migrants and

their habitats. The Kenya and Tanzania governments are already mapping wildlife corridors and migratory routes with the aim of securing critical wildlife areas (Jones et al., 2009; MEMR, 2012; TAWIRI and WCS, 2013). In other initiatives, researchers are collaring wildebeest to track their movements to understand how landscape fragmentation and climate change are affecting wildebeest, and reporting their movements online (CSU, 2013).

Conserving migrations requires a proactive approach, anticipating and responding to threats before the abundance of migrating animals is critically reduced, and thus the phenomenon of migration long gone (Harris et al., 2009; Wilcove and Wikelski, 2008). In this regard, conservation organisations such as the Convention of Migratory Species, which works to conserve migrations of species threatened with extinction, could be expanded to conserve threatened or endangered migrations, and not just those which contain rare or endangered species (Harris et al., 2009).

Efforts to secure dispersal areas and migratory corridors will require an integrated approach to land use planning both inside and outside of protected areas. By taking into account wildlife and their migratory routes, people, livestock, landscapes and natural resources, a more comprehensive conservation effort can be made. Thus, there is a need to work collaboratively with landowners and users to identify threats along migratory routes so these critical areas can be effectively protected. Extensive consultation with communities and landowners, as well as governments, conservation organisations and other stakeholders, must be a prerequisite to any action. The rapid and dramatic wildebeest population declines in East Africa calls for urgent, comprehensive and decisive remedial steps to protect the remaining populations and rehabilitate their habitats. This will enhance their resilience to the intensifying droughts and contribute to the sustainability of local livelihoods.

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Writer: Claire Bedelian[a]

Production and Outreach Team: Arshia Chander[b], Erick Litswa[c], Kim Giese[b], Lindsey Harriman[b], Michelle Anthony[b], Reza Hussain[b], Tejaswi Giri[b], Theuri Mwangi[c] and Zinta Zommers[c]

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([a] University College, London, [b] UNEP/DEWA/GRID-Sioux Falls, [c] UNEP/DEWA-Nairobi, [d] University of Hohenheim, [e] Conservation Biologist, Kenya, [f] UNEP-WCMC, [g] Munk School of Global Affairs, University of Toronto)

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