South Western Mau Forest Reserve

Game-proof Barrier Feasibility Study

Report prepared for ISLA/IDH by Rhino Ark Charitable Trust.

Consultants:

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This game-proof Barrier Feasibility Study was sponsored by IDH, the Sustainable Trade Initiative under the ISLA (Initiative for Sustainable Landscapes) being implemented in the South West Mau. ISLA, through a multstakeholder approach, aims to restore and conserve 60,000 hectares of South West Mau Forest by 2030 through innovative and sustainable solutions to deforestation and forest degradation by addressing livelihoods, water, sustainable energy and ultimate holistic landscape management. At the core of ISLA's action plan is the buffering of the North Easthern boundary of the South West Mau Forest Block alongside livelihood improvement for surrounding communities.

The views expressed here are those of the authors. They do not necessarily reflect the views of Rhino Ark Charitable Trust, the Initiative for Sustainable Landscapes, Kenya Forest Service, or Kenya Wildlife Service.

All photographs and maps by Yvonne de Jong and Tom Butynski.

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Cover photograph: Hilgert's vervet monkey *Chlorocebus pygerythrus hilgerti* foraging in a tea plantation near Kericho.

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EXECUTIVE SUMMARY

In most places in Kenya, natural forests within protected areas (*e.g.,* forest reserves, national reserves, and national parks) are adjacent to land with a high human population density, a high human population growth rate, intensive cultivation, and inadequate law enforcement and management as concerns the use and protection of natural resources, including the water catchment. Conservation buffer zones are either absent or small, undeveloped, and poorly managed and protected. As such, there is often an unacceptable level of damage by wildlife to crops, livestock, farm infrastructure, tree plantations, and people. Concomitantly, there is often illegal, unsustainable, use of the natural forest by people, particularly those living closest to the forest, and severe damage to the water catchment.

Given this situation, if substantial wildlife populations are to continue to exist in Kenya's natural forests, and if what remains of the Nation's high-quality water catchment is to be protected, the Kenya Forest Service (KFS), Kenya Wildlife Service (KWS), and Government of Kenya, seem to have no better option than to erect electric game-proof fences between local communities and protected areas. There are two main objectives of electric game-proof fences: (1) minimize the movement of large mammals onto croplands and settlements so that human-wildlife conflict is minimalized, and (2) control the taking of forest products by people so that use becomes sustainable and the conservation values of the natural forest and water catchment are enhanced.

A main focus at this time for those concerned with forest and water catchment conservation in Kenya is the South Western Mau Forest Reserve (SW Mau FR). The SW Mau FR has had both its size (38% lost) and conservation values substantially reduced over the past 85 years. In 2001, 234 km² was excised. The SW Mau FR was 953 km² in 1932 but only 600 km² in 2016. Of the remaining 600 km², 182 km² is grassland/scrub/bracken fern, 404 km² is forest (although much of this is degraded and fragmented), and 8.2 km² is encroached and covered with crops, exotic trees, pasture, and settlement.

Given the effectiveness of comprehensive game-proof electric fencing in protecting other natural forests in Kenya (*e.g.,* Aberdare, Mt. Kenya, Eburu), this study of SW Mau FR was commissioned to:

- Assess human-wildlife conflict.
- Assess options for reducing deforestation and human-wildlife conflict by means of a physical barrier.
- Assess local peoples' requirements for access to the SW Mau FR should a physical barrier be established.
- Assess local peoples' attitudes towards (1) forest conservation and (2) a physical barrier.
- Assess implications of a physical barrier for the local people and their use of the forest.

- Assess local peoples' potential role in the establishment of a physical barrier.
- Assess the implications of a physical barrier on management of the SW Mau FR.
- Assess the likely impacts of a physical barrier on wildlife.
- Assess the suitability of the terrain for a physical barrier and determine the optimum placement of the physical barrier.
- Identify ways to engage local people in conservation.

The ultimate objective of an electric game-proof fence for SW Mau FR is to establish a long-term win-win situation whereby (1) the conservation values of this ecosystem are improved and maintained, (2) sustainable exploitation of the natural resource base is established, and (3) the level of human-wildlife conflict is substantially reduced. If this situation can be created, the big winners will be the people of Kenya, particularly those living nearest the forest.

This report contains details on the history, topography, environment, vegetation, and wildlife of SW Mau FR, as well as on the the socio-economic situation, human-wildlife conflict, and conservation policies and agreements that affect the conservation of this area. Also included is a review of the literature concerned with the human and natural environments of SW Mau FR.

The main outputs of this study are:

- A multi-disciplinary database for the game-proof electric fence, including baseline data for monitoring the impacts of the fence on the local communities and SW Mau FR.
- A plan for fencing the 2001 east excision boundary of the SW Mau FR, including fence and gate placement.
- An impact assessment of the proposed fence.

Data for this report were collected by:

- Two Co-Project Leaders who developed and managed this study, undertook the desk study, conducted the forest exploitation and wildlife transects (41 hours, 397 km of vehicle transects; 49 hours, 89 km of foot transects), led three barazzas (40-300 participants each), analysed the data, and wrote the final report.
- Three Field Technicians who gave three types of questionnaires (total 297 questionnaires given).
- Three pairs of KFS Rangers (a different pair for each study section) who provided security, served as guides and interpreters, and assisted with questionnaires.

The following are the main results from the 297 forest-adjacent household questionnaires given to dwellers living in the W Mau FR and SW Mau FR study area:

- Mean number of years households on the farm: 15
- Mean distance from forest reserve 2001 excision boundary: 185 m
- Mean size of farm: 3.8 acres (48% cropland, 34% pasture, 10% woodlot/forest, 8% other)
- Main crops: maize, potatoes, beans, wheat, tea, cabbage
- Mean number of livestock: 12.4 (6.1 cattle, 4.5 sheep, 1.8 goats)
- Damage to crops by wildlife: 76% said "a lot"
- Loss of livestock to wildlife: 63% said "a lot"
- Damage to infrastructure by wildlife: 76% said "a lot"
- Species that caused the most damage: porcupine, elephant, hyaena
- How they use SW Mau FR: 85% grazing, 74% firewood, 72% medicine, 53% honey
- "Would you be happy with a fence?": 98% said "yes"
- "What do you prefer as a barrier, a Nyayo Tea Zone, or a fence?": 95% fence, 2% NTZ, 3% no opinion
- They believe that a fence is better than a Nyayo Tea Zone because it would:
  - Be more effective for reducing human-wildlife conflict
  - Be more effective for forest protection
  - Give them more access to the forest
  - Provide more jobs

Main threats to SW Mau FR as determined by forest exploitation and wildlife transects:

- Encroachment
- Livestock grazing and browsing
- Fire
- Firewood collection

- Charcoal making
- Removal of trees
- Debarking of trees
- Poaching of wildlife

Main conclusions:

- Exploitation of SW Mau FR continues to be high and unstainable for most forest products, particularly for wood products. Exceptions appear to be honey, bamboo, and butterflies.
- SW Mau FR is not recovering from past over-utilization. Heavy grazing and browsing by livestock is preventing recovery, particularly in the former encroached area. This has led to large areas of heavily eroded soil and the failure of projects that planted indigenous trees (<2% of seedlings survive).
- Main use of SW Mau FR by forest-adjacent dwellers is for grazing, firewood, medicines, and honey.
- Biodiversity of the former encroached area is low, as is the abundance of larger mammals and birds. Some species are no longer present.
- There are no effective controls on exploitation of forest products.
- There is an encroached area of about 8.2 km² at the south end of the survey area.
- Forest-adjacent farms (mean size=3.8 acres) are highly productive, with a mix of cropland, pasture, and woodlot. Mean number of livestock/farm is 12.4.
- Typically, within 2 km of the east 2001 excision boundary of SW Mau FR, there are more trees outside the Forest Reserve than inside.
- Community Forest Associations (CFA) needed. Now weak!
- It appears that this is a region of very rapid human population growth. Human population near the forest is likely to double in <25 years.
- Level of conflict with wildlife is high, particularly as concerns damage to crops, livestock, and infrastructure. Main problem animals are porcupines, elephants, and hyaenas.
- Given the unsustainable use of SW Mau FR and the high level of human-wildlife conflict, a barrier is required to help control and manage the taking of forests products, protect the

water catchment, and reduce human-wildlife conflict.

- Almost all (98%) of the 297 forest-adjacent dwellers in the W Mau FR and SW Mau FR study area who were interviewed through questionnaires said that they would be "happy" with an electrified fence barrier. 95% said that they "prefer" an electrified fence barrier to a Nyayo Tea Zone barrier.

The question of whether game moats or Nyayo Tea Zones might be alternatives to electric game fencing along the east excision boundary of SW Mau FR was examined. As concerns moats, the conclusion of this study is that they should not be used as they are (1) expensive to construct and maintain, (2) greatly affected by terrain and soil moisture, and, (3) most importantly, are incapable of controlling the movement of people and livestock into protected areas.

As concerns Nyayo Tea Zones, their overall impact on the environment and effectiveness for conservation of natural forest has yet to be documented or evaluated by independent study. Of forest-adjacent dwellers, 95% said that they prefer a fence to a tea zone. A 'Nyayo Bamboo Zone' may be a better option for the conservation natural forest. There may be an opportunity here for a pilot study of the Nyayo Bamboo Zone concept to assess its feasibility, costs, and contributions to the conservation of natural forest.

The positive and negative impacts of an electric game-proof fence for the eastern boundary of SW Mau FR were assessed. This study concludes that an electric game-proof fence would, overall, be very positive for the conservation of this forest. Without the fence, the conservation values of SW Mau FR will, undoubtedly, continue to erode, negatively affecting the well-being of millions of Kenyans and further eroding the Nation's valuable biodiversity. This study recommends measures to mitigate against the negative effects of the electric fence, and suggests activities that will increase the effectiveness of the fence and reduce pressures from local communities on the resources of SW Mau FR.

Main recommendations:

- Construct a 40.7 km 'comprehensive game-proof electric fence' (with wire mesh added) and 14 access gates along the present east 2001 excision boundary of Western Mau Forest Reserve and SW Mau FR. Communities should be consulted as to the exact location of the gates. The terrain allows for fence construction.

- Remove all encroachers from the SW Mau FR. The area encroached is *ca*. 8.2 km².

- Greatly improve law enforcement and management of KFS and KWS staff on the ground.

- Hire forest-adjacent dwellers to undertake large-scale projects to plant indigenous trees throughout the open areas of the former encroached area (190 km²) of SW Mau FR, as well as on former exotic tree plantations of Western Mau Forest Reserve. A game-proof electic fence is required to protect these trees from livestock. This will speed recovery of the forest, create a large number of jobs, provide wood products, and enhance honey production.

- If further evaluation allows, establish projects that substantially increase production of honey in SW Mau FR. Where traditional beehives are used, they should be constructed of wood from trees grown outside of the Forest Reserve.

- Evaluate opportunities for butterfly farming as a means of creating jobs in SW Mau FR.

- If further evaluation allows, substantially increase the sustainable harvesting of bamboo in SW Mau FR.

- Establish CFAs all around SW Mau FR. Ensure that the Ogiek are heavily involved in CFA decisions and activities.

- Strengthen CFAs through training, education, participation in decision-making, and problem solving. Support CFA conservation activities (*e.g.*, establishing tree nurseries and planting indigenous trees).

- Move all KFS stations from the excised area to near the current east 2001 excision boundary of SW Mau FR.

- Promote tree growing on adjacent farmland, particularly of indigenous tree species.

- Encourage establishment of more and better schools, and of family planning programmes in the region.

- Undertake a game-proof barrier feasibility study of the 'West Mau Forest Reserve Conservation Corridor' that connects to the SW Mau FR. This vital corridor is now largely comprised of exotic tree plantations and is only *ca.* 1.8 km wide. These plantations should be emoved and the corridor planted with indigenous trees.

- Undertake an independent evaluation of the effectiveness of the Nyayo Tea Zone as a tool for reducing human-wildlife conflict and for the conservation of montane forest.

- Undertake an independent evaluation of progress to date towards rehabilitation of the forests and water catchments of the Mau Forests Complex, particularly in the SW Mau FR. What has been achieved to date, how, by whom, and at what cost? What actions have been successful and what actions have failed, and why? What are the lessons learned that can be used to guide future forest rehabilitation efforts?

Comprehensive game-proof electric fence with wire mesh:

- Located along the southeast boundary of Western Mau Forest Reserve and along the east 2001 excision boundary of SW Mau FR.

- Length: 40.7 km
- 14 gates (2 pedestrian/vehicle gates; 12 pedestrian gates)
- Average distance between gates: 2.8 km
- Cost of fence construction: *ca.* US$ 1,017,500
- Annual cost of fence maintenance: *ca.* US$ 40,700
- Principal for fence maintenance trust fund: *ca.* US$ 582,000–814,000

In conclusion, this study recommends the construction of a 40.7 km comprehensive game-proof electric fence (with wire mesh), with 14 access gates, along the east 2001 excision boundary of the SW Mau FR. This fence will protect the eastern flank of this species-rich moist montane forest and high-value water catchment. The placement of this fence takes into consideration many guidelines and constraints, and is judged suitable for the long-term conservation of the eastern flank of the SW Mau FR. The *ca.* 8.2 km² of encroached land should be repossessed and planted with indigenous trees.

DEFINITIONS AND ABBREVIATIONS

DEFINITIONS

For convenience and clarity, this report uses the following terms and definitions:

"**local people**" or "**local community**" or "forest-adjacent dweller": People or communities located within 1 km of the boundary of the Western Mau Forest Reserve or South Western Mau Forest Reserve.

"**encroachment**": Cultivation, grazing, occupation or other use of land within the Western Mau Forest Reserve or South Western Mau Forest Reserve which is without the authority of the Kenya Forest Service.

"**excised area**": Forest land excised by Government to individuals and farming, the excision process of which is challenged before the High Court. The High Court issued an order restraining Government from further implementing the planned excision.

ABBREVIATIONS

ADB	African Development Bank
CFA	Community Forest Association
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
ISLA	Initiative for Sustainable Landscapes
IUCN	International Union for the Conservation of Nature and Natural Resources
NTZDC	Nyayo Tea Zone Development Corporation
KIFCON	Kenya Indigenous Forest Conservation Programme
KFS	Kenya Forest Service
KWS	Kenya Wildlife Service
MGM	MGM Environmental Solutions Limited, Consultants, UK
NEAP	National Environment Action Plan
SSC	Species Survival Commission
SW Mau FR	South Western Mau Forest Reserve
W Mau FR	Western Mau Forest Reserve

INTRODUCTION

Where ever they occur in Kenya high potential areas, natural forests within protected areas are adjacent to areas of high human population density and intensive land-use, particularly agriculture. As such, there is typically a "hard line" between the forest and its wildlife, and the people and their crops and livestock. For various reasons, conservation buffer zones are either completely absent or small and poorly developed. This means that there is usually some level of damage by wildlife to crops, livestock, farm infrastructure, and tree plantations. Occasionally wild animals, such as savanna elephant *Loxodonta africana*, African buffalo *Syncerus caffer*, and lion *Panthera leo,* injure or kill people. This damage frequently has severe negative impacts on the well-being of local people, on the local economies and politics, and on the conservation of the protected area.

Given these circumstances, if substantial wildlife populations are to continue to exist in what little remains of Kenya's natural forest, the Kenya Wildlife Service (KWS) and the Kenya Forest Service (KFS) seem to have no option but to erect barriers between local communities and the protected areas (DHVC, 1992; Butynski, 1999). The objective of erecting barriers is typically two-fold: (1) to minimize the movement of large mammals into areas of intensive agriculture and settlement, and (2) to control the taking of forest products by people so that use might be made sustainable.

Figure 1. Kaptich, South Western Mau Forest Reserve, Kenya.

Upon completion of their review of wildlife barriers, DHVC (1992) concluded that "*...community attitudes and opinions clearly demonstrated the low tolerance levels of rural communities towards wildlife in general, but communities were more supportive where effective barriers had been erected. Most communities resented the damage caused by wildlife, particularly elephant, and were of the opinion that wildlife should be confined to national parks using physical barriers or their numbers should be reduced*."

In the past, crop barriers, high tensile steel fences, game moats, scaring techniques, and animal removal, have been among the methods used to deter wildlife from leaving the natural forest and doing damage. Some of these methods were fairly effective for a time, but eventually failed. Reasons for failure include poor construction, lack of maintenance, mismanagement, and inadequate long-term funding.

One of the objectives of KFS and KWS is to protect people and property from injury or damage from wildlife (KWS, 1990). As such, both institutions strive to reduce the level of human-wildlife

conflict in areas where conflict is greatest, and particular where the protected area (*e.g.*, national park, national reserve, or forest reserve) has high conservation values (*e.g.*, water catchment, biodiversity, tourism, forest products). One such area is the South Western Mau Forest Reserve (SW Mau FR) in southwest Kenya. Others are the adjacent Western Mau Forest Reserve (W Mau FR) and the adjacent Transmara Forest Reserve (Transmara FR) (Wass, 1995; Bennun & Njoroge, 1999; PSDLVB, 2003; WRI, 2007; Nabutola, 2010; RMFC, 2010; SMCA, 2016).

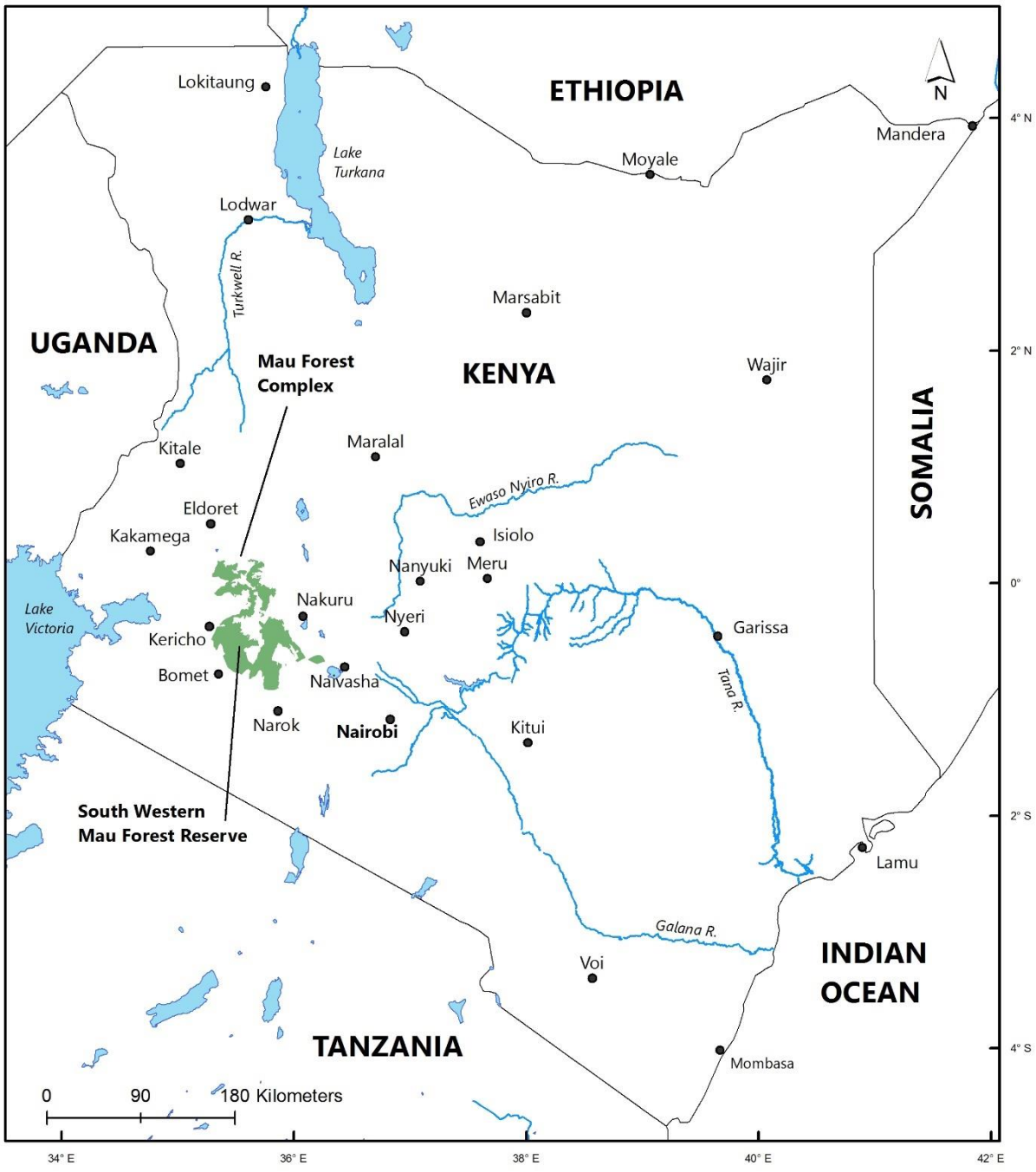


Figure 2. Mau Forests Complex (in green), Kenya.

One of the major considerations at this time for the conservation of what remains of the natural forest of the SW Mau FR is the construction of a barrier around part or all of the area (Figures 3).

Once on the ground, early on in this study, it became obvious that the long-term conservation of the SW Mau FR was dependent on the continued connectivity with the W Mau FR. Thus, we have included the southern-most part of the W Mau FR in this study. As such *ca.* 8 km (18%) of the study area lies within, or adjacent to, the W Mau FR (Figure 6).

The proximate objectives of this barrier would be to (1) protect adjacent agricultural crops, forest plantations, livestock, and people from damage by wildlife, and to (2) help KFS regain control of, and effectively manage, the exploitation of the natural resources of W Mau FR and SW Mau FR, thereby allowing for long-term, sustainable use. The ultimate objective (and challenge) of this effort would be to create a long-term win-win situation whereby (1) the conservation values of the W Mau FR and SW Mau FR are improved and then maintained, (2) sustainable exploitation of the natural resource base is established, and (3) the level of human-wildlife conflict is substantially reduced. If this objective can be achieved, the big winners will be the people of Kenya, particularly those living near the W Mau FR and SW Mau FR.

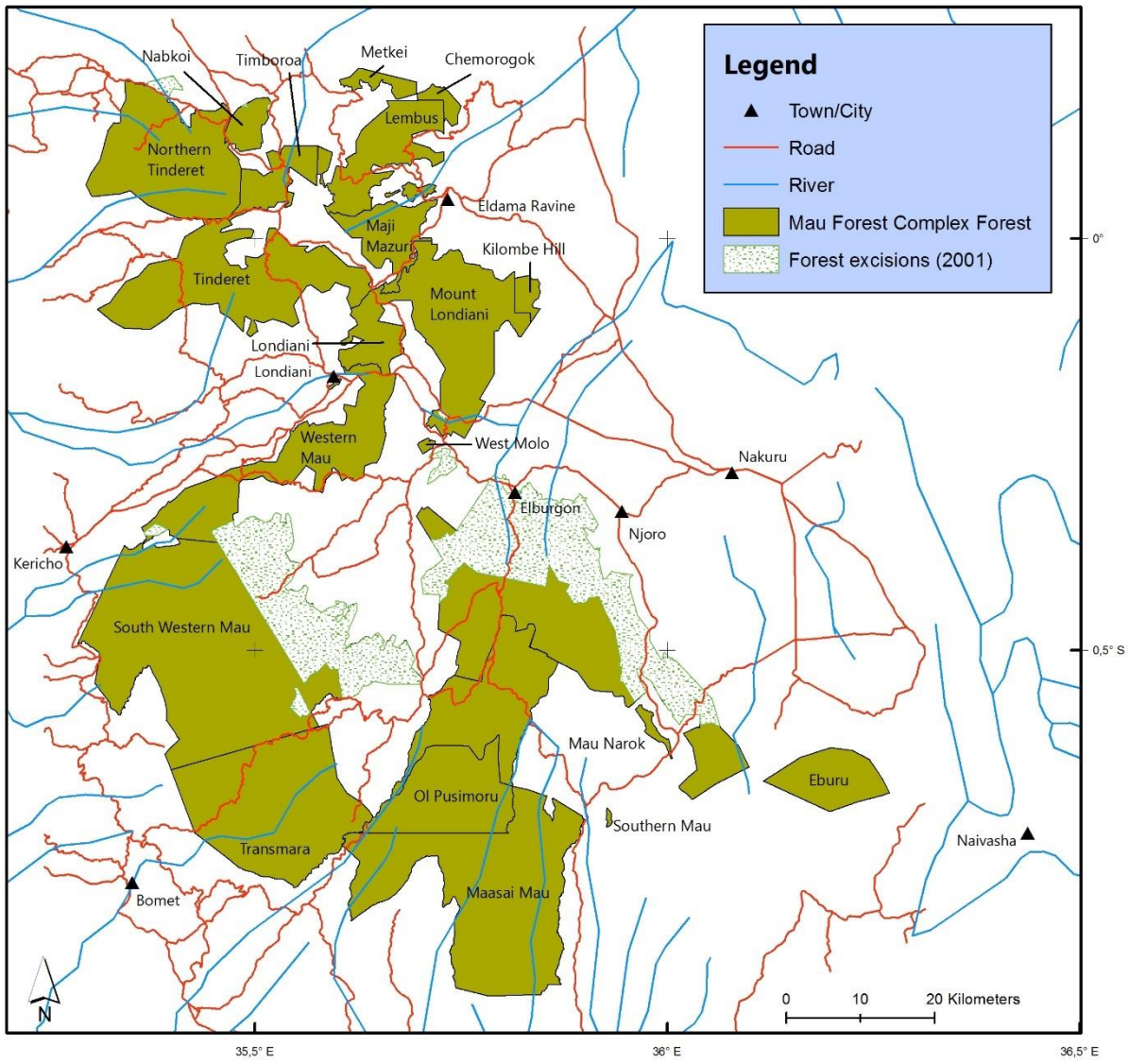


Figure 3. Mau Forests Complex, Kenya, as of 2015.

IMPACT OF A WILDLIFE BARRIER ON PEOPLE ADJACENT TO THE SOUTH WESTERN MAU FOREST RESERVE

Wildlife in Kenya (indeed, in many other parts of the world) has become the object of much derision, being responsible for extensive crop damage and often involved in other conflicts with humans. This leads to a general negative attitude towards wildlife and natural ecosystems as people's levels of fear are increased and wildlife is perceived as a threat to their well- being. This situation is most prevalent in and around protected areas. Concentrations of wildlife, coupled with a perception that government officials are more concerned with the protection of wildlife than with the needs of the people, makes for an uneasy relationship between communities, wildlife, and protected area staff. In some instances, the frustrations of these communities are manifested in acts of revenge which can damage protected habitats and threaten the plant and animal populations therein.

Another aspect of the relationship between communities and protected areas is the consumptive use of natural resources. The construction of houses, fences, and other structures requires lumber and poles, and the lack of gas stoves or electricity means that people burn a large amount of fuelwood. Additionally, livestock owners use Kenya's protected areas to graze their animals and to collect grass. These and other uses of protected areas have taken a considerable toll on the viability of that land as habitat for wild species, and have threatened its sustainability as a source of products for humans and livestock.

Figure 4. Fence made of local materials on the edge of the 2001 excision boundary of the Western Mau Forest Reserve, Kenya.

The 'South Western Mau Game-proof Barrier Feasibility Study' was proposed in order to reduce some of these problems. By effectively establishing a barrier, and restricting or limiting the passage both of humans and wild animals across a barrier, it is expected that many of the above-mentioned conflicts can be significantly reduced, if not resolved.

Without the fear and high level of crop damage associated with a close proximity to wild animals, people living near the W Mau FR and SW Mau FR will experience more stability and come to

appreciate the wildlife and ecosystems as positive aspects of their environment. Through the sustainable use of the many resources of the W Mau FR and SW Mau, future generations of people will be assured continuing benefits from this vital ecosystem.

Figure 5. School children on the edge of the 2001 excision boundary of the South Western Mau Forest Reserve, Kenya.

As the understanding and cooperation of surrounding communities is fundamental to any conservation project, efforts must be made to assess the attitudes and relevant practices of those people most likely to be affected by, or have an effect upon, its implementation. In order to assess attitudes towards the W Mau FR and SW Mau FR barrier and its impact on the people of the region, members of the communities adjacent to the proposed barrier-line were interviewed regarding various aspects of their relationship with the forest and its wildlife, and the anticipated impact of the barrier on their lives. This section of this study report provides a tabulation of the results of the interviews, a discussion of community issues, and a list of recommendations.

THIS STUDY AND ITS OUTPUTS

MAIN PURPOSE AND ACTIVITIES OF THIS STUDY

Here are the main activities of the South Western Mau Game-proof Barrier Feasibility Study, as stated in Annex I of the contract (dated 4 January 2016):

- Identify local communities' use of the forest along the eastern boundary and describe their profile and motivations (*e.g.*, firewood, commercial logging, commercial charcoal production, timber, cattle grazing, *etc.*);
- Assess human-wildlife conflicts along the eastern boundary and identify hotspot areas and communities to include in the study;
- Assess options for reducing deforestation and human-wildlife conflicts by means of a physical barrier. Options include, but are not limited to, the planned Nyayo Tea Zone and fencing. With regard to the planned Nyayo Tea Zone, a meeting should be convened between the consultants, the Nyayo Tea Zone Development Corporation Regional Manager and the IDH/ISLA team.
- Assess local communities' requirements for access to the Forest Reserve should a physical barrier be established. This should take into consideration the management plans and management agreements between CFAs and KFS;
- Through focus group discussions and interviews, assess local communities' attitude towards (i) forest conservation and (ii) a physical barrier like a fence, or tea zone;
- Assess implications for local communities and forest use of a physical barrier;
- Assess local communities' potential role in the establishment of a physical barrier (*e.g.*, building and maintenance, job opportunities);
- Identify ways to engage the local communities in conservation;
- Assess the implications of a physical barrier on management of the Forest Reserve (*e.g.*, for KFS, KWS, CFA);
- Assess the likely impacts of a physical barrier on wildlife; and,
- Assess the physical suitability of the terrain for a physical barrier and determine the optimum placement of the physical barrier as well as sites to start (if a phased approach for building a physical barrier is recommended).

The team that will carry out the study will be led by two consultants; one of whom undertook the Aberdare Fence Feasibility Study in 1999. See: http://www.wildsolutions.nl/5026-2/

The lead consultants will also:

- Align the recommendations with the baseline results and the Monitoring & Evaluation work of CIFOR, available mid-February; and,
- Provide expertise and input to ISLA master plan meetings.

The South Western Mau Game-proof Barrier Feasibility Study compiled existing information as well as considerable new data in order to (1) make informed management decisions and recommendations for the possible construction of a wildlife barrier, and to (2) provide baseline data against which to monitor impacts of development and conservation initiatives inside of the eastern boundary of the SW Mau FR, particularly in the vicinity of the SW Mau FR east 2001 excision boundary.

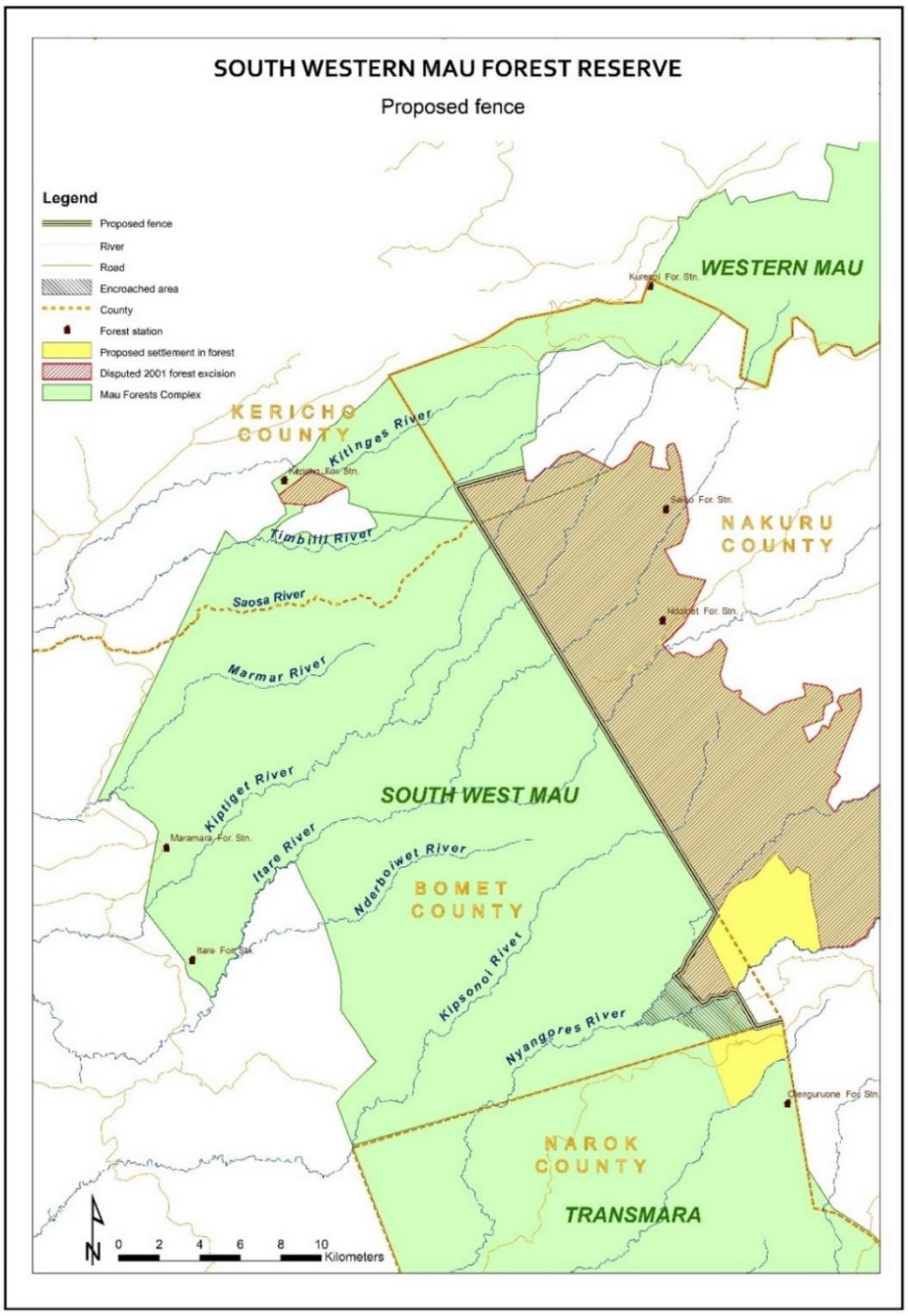


Figure 6. Location of SWM FR. The proposed comprehensive game-proof electric fence with wire mesh follows the east boundary of the Western Mau Forest Reserve and then the SWM FR 2001 excision boundary.

RESEARCH EFFORT

This project was undertaken by a team comprised of two Ecologists/Project Co-Leaders, three Research Technicians, six KFS rangers, and a camp-keeper. The following is a summary of some of the work that was undertaken during this study:

- Established eight field camps in or near the eastern boundary of the SW Mau FR.
- The Project Co-Leaders and three Research Assistants conducted 14 person-days of field work.
- Interviews of 297 people by the Research Technicians (Appendices 1 and 2) .
- 'Vehicle transects' for a total of 397 km (41 h) by the Project Co-Leaders.
- 'Foot transects' for a total of 89 km (49 h) by the Project Co-Leaders.
- Three barazzas held on the boundary of the SW Mau FR in which about 365 people participated, including the Project Co-Leaders, IDH/ISLA, KFS, and community leaders.
- Meeting held in Nairobi among the Project Co-Leaders, Nyayo Tea Zone Development Corporation, and IDH/ISLA.
- Project Co-Leaders presented finding at, and participated in, a 2-day stakeholders' master planning workshop in Nairobi.
- Project Co-Leaders drafted the project's final report.

RESEARCH TEAM LEADERS

The research team was led by the following two people:

Tom Butynski, PhD. Wildlife Ecologist/Conservation Biologist. Currently Director of the Lolldaiga Hills Research Programme and Co-Leader of the Eastern Africa Primate Diversity and Conservation Programme. Worked in Africa since 1970, mostly in Botswana, Kenya, Uganda, Tanzania, Congo, and Equatorial Guinea. Currently a member of four IUCN/Species Survival Commission Specialist Groups (Primates, Antelopes, Afrotheria, Wild Pigs). Served as Director of the Institute of Tropical Forest Conservation in Uganda, Leader of Zoo Atlanta's Africa Biodiversity Conservation Program, Director of Conservation International's Eastern Africa Biodiversity Hotspots Program, Director of King Khalid Wildlife Research Centre in Saudi Arabia, Vice-Chair of the Africa Section of the IUCN/SSC Primate Specialist Group, Senior Editor of *African Primates*, and Editor of *Mammals of Africa.* His CV and list of publications can be viewed at: www.wildsolutions.nl

Yvonne de Jong, PhD. Primatologist/Conservation Biologist. Co-Leader of the Eastern Africa Primate Diversity and Conservation Programme. Conducted research in Africa since 2000, mostly in Kenya, Tanzania, and Uganda. Currently a member of three IUCN/Species Survival Commission Specialist Groups (Primates, Afrotheria, Wild Pigs) and the National Primate Taskforce (KWS). Her CV and list of publications can be viewed at: www.wildsolutions.nl

TYPES OF PHYSICAL BARRIERS

WILDLIFE CONFLICT AND ILLEGAL EXPLOITATION OF NATURAL FOREST

Figure 8. Kibaraa, Western Mau Forest Reserve, Kenya. Notice the extensive use of bamboo for fence construction.

There has be rapid escalation of conflict between people and wildlife over the past century. This conflict is worldwide, but is most obvious and serious in developing countries with a rapidly expanding human population (typically doubling in less than 25 years). Kenya is one of these countries. As human populations grow, the natural resources available to each individual become increasingly less and wildlife populations become smaller, fragmented, and prone to extirpation. Conflicts (not only between people and wildlife but also among people) become ever more frequent, severe and complex as people scramble to secure ever more scarce and, thus, ever more valuable, natural resources.

Montane forest lands, with their relatively rich soils and good rainfall, generally have high agricultural potential. As such, montane forests have probably been more extensively destroyed than any other forest type in Africa. From both the perspectives of biodiversity conservation and long-term human survival, this is of enormous concern.

With extensive loss of habit, populations of many forest-dependent species of wildlife (*e.g.*, mountain bongo *Tragelaphus eurycerus isaaci*, giant forest hog *Hylochoerus meinertzhageni*, African golden cat *Caracal aurata*) have become compressed into increasingly small areas—or extirpated. At the same time, human population densities have continued to increase on the boundaries of protected forests. As resources have become scarce, people have become less tolerant of the negative impacts of wildlife.

In Kenya, damage to crops (*e.g.,* maize, beans, Irish potatoes, and wheat) by elephant, buffalo, baboon, Sykes's monkey, bushpig, and crested porcupine *Hystrix* sp. can be locally important, as can predation on livestock by lion, leopard *Panthera pardus*, and hyaena (Anon., 1991; KIFCON, 1992; Butynski, 1999). While wild animals encroach upon and do damage to agricultural lands and exotic tree plantations, people around the W Mau FR and SW Mau FR have encroach upon protected wildlife habitat, destroying the wildlife directly through poaching, or indirectly by degrading, fragmenting, and eliminating habitat on which wildlife depends. Around the W Mau FR and SW Mau FR, the pressure to illegally remove forest products, or to illegally destroy forest to establish farm plots, is high.

At this time, the authorities have difficulties managing the W Mau FR and SW Mau FR, or protecting crops, livestock, and people around these forests. Establishing a barrier to the movement of wildlife out of these two Forest Reserves, and to the movement of people into them, is widely believed to be a necessary step towards both significantly reducing the level of conflict between people and wildlife, and towards helping to ensure that over-exploitation of the natural resources of these Forest Reserves is stopped.

Figure 9. Kibaraa, on the Western Mau Forest Reserve 2001 excision boundary. The excised area, on the right, and is now covered by cropland and pasture. The non-excised, former encroached, area is on the left. Notice the near absence of trees on the former encroached area. The proposed barrier will run along this excision boundary.

TYPES OF PROTECTIVE MEASURES

Various defense and protection measures to reduce or eliminate damage by wildlife have been used with some success in southern and eastern Africa (DHVC, 1992; MGM, 1999). These can be classified as follows:

- Raising human tolerance thresholds (*e.g.*, improve attitudes, monetary compensation, revenue sharing);

- Deterrence of wild animals (*e.g.*, direct deterrence by residents, disturbance hunting, change cropping practices, bright light, fire, noise, dogs);

- Removal of animals (*e.g.*, control shooting, problem animal removal quotas, translocation, chasing);
- Changing the habitat;
- Construction of physical barriers.

WHY A PHYSICAL BARRIER FOR THE SOUTH WESTERN MAU FOREST RESERVE?

The Mau Forests Complex represents the largest area of montane closed forest in Kenya. Large tracts of the original natural forest of the Mau Forests Complex ecosystem have been destroyed for agriculture and human settlement, while most of what remains has been degraded through the unsustainable removal of forest products and fragmentation. Given the high demand for land and forest products in southwest Kenya, and the rapid human population growth in the region, all of the W Mau FR and SW Mau FR must be considered under severe threat at this time.

Figure 10. Kipkoris on the South Western Mau Forest Reserve 2001 excision boundary. The former encroached area, on the left, is without indigenous tress and has reverted from cropland to heavily used livestock pasture. Forest regeneration is not possible under the present, unrestricted, livestock grazing and browsing.

All along the east boundary of the W Mau FR and along the SW Mau 2001 excision boundary there is a high human population density. There is near complete loss of forest on the farmlands to the east and for 2-3 km to the west on the former encroached land. Once a 'hard edge' like this has developed, there is little option for conservation of a forest but to separate the forest from the people by erecting an effective physical barrier. Such a barrier does not necessarily mean that people no longer have access to the forest and forest products, but it should mean that the management authorities are able to gain control of the situation so that utilization of the forest can be undertaken in a controlled, managed, and sustainable manner. A barrier also does not mean that other protective measure are not also employed. For example, community education, awareness and conservation campaigns, problem animal removal, *etc.*, are still required activities to be undertaken hand-in-hand with the barrier.

TYPES OF PHYSICAL BARRIERS

In its detailed review of approaches to the control of wildlife in Kenya, FAO (1994) concluded, "*Forest protection will require the visualization of the recognized boundary through some form of*

barrier, as access to the forest will have to be limited and controlled via pre-determined gates and roads. This can only be achieved through a physical barrier, be it a moat or a fence."

Game Moat

Game moats were widely constructed during Kenya's colonial period, particularly in Laikipia District, at Maralal, and in Mt. Kenya, Meru, Tsavo, and Aberdare National Parks. In Aberdare, moats were constructed around most of the National Park. The main reason for putting in moats was to prevent wildlife, especially elephants, from moving onto farmlands. Due to their limited success, game moats have not been used extensively in southern Africa (DHVC, 1992) where most of the testing of wildlife barriers for use in Africa has been undertaken.

Moats are labour intensive and expensive to construct (DHVC, 1992; Hoare, 1992). The recommended game moat for forests in Kenya (Clark, 1965) requires that a 9-18 m (preferably 18 m) wide strip be cleared of all vegetation (including large hardwood trees) and that the moat itself be 1.2 m deep and 1.8 m wide. Thus, 1.8 ha of forest would be cleared for every 1 km of moat constructed. These moats require that there be one maintenance person/2 km of moat and that the entire moat be check daily and immediately repaired. The moat constructed in the Salient in the 1960s required one maintenance person/0.7 km (Woodley, 1965).

Initially, moats may be effective against elephants and non-jumping species. With time, however, elephants learn to negotiate moats. More importantly, in most places where they have been constructed, there has been almost a total lack of maintenance of the moats. In Kenya, game moats were construction with little involvement of the local communities. As such, these communities came to view moats as foreign and belonging to Government. Moats can be effective barriers for elephants and other wildlife, but effectiveness is determined by design, depth, and level of maintenance (Clark, 1965; Woodley, 1965; Manegene *et al.*, 1997). Also, moats are limited to areas with suitable soil characteristics that provide adequate drainage and that are not prone to erosion. Moats are not good choices in areas where there are sandy, swampy or rocky soils, or in hilly, steep terrain where soils are unstable. Areas of high rainfall or which are regularly flooded are also unsuitable. Moats interrupt drainage systems causing considerable soil erosion. They also create artificial stagnant bodies of water that may become health hazards. They require extensive maintenance by large numbers of labourers, both because of erosion and resultant slippage of soil, and because elephants learn to cave in the sides to negotiate the moat. DHVC (1992) rated the effectiveness of game moats for the control of elephants as low.

This study found the eastern boundary of the W Mau FR and the SW Mau FR eviction boundary to be unsuitable for the construction of a moat. Some of this boundary is on hilly terrain where rainfall is relatively high (mean annual rainfall *ca.* 130 cm, and there are several valleys, some with permanent streams that sometimes flood. Moats require a high level of frequent maintenance under these conditions and are completely ineffective as barriers near and on watercourses. Where moats might be effectively

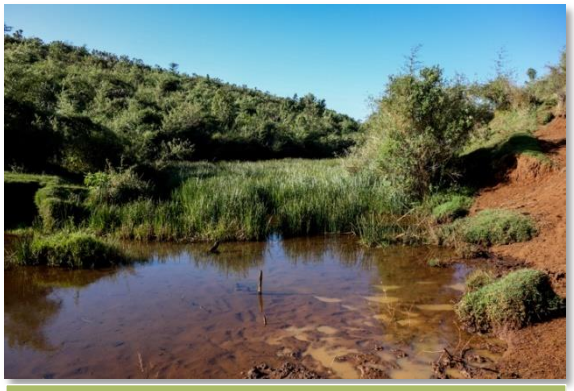


Figure 11. Kipkoris, on the South Western Mau Forest Reserve 2001 excision boundary.

constructed, such as on the more gentle terrain, there are serious problems with illegal encroachment and unsustainable exploitation of forest products. A huge disadvantage of moats is that they are not a barrier to people or their livestock. As such, moats cannot assist the management authorities in controlling the removal of forest products by people and livestock. In short, even the best built, best maintained and most effective moat placed in ideal conditions can never do more than one-half of the job required of a physical barrier in the W Mau FR and SW Mau FR.

This study did not find any area along the eastern boundary of W Mau FR or along the SW Mau FR 2001 excision boundary where controlling human access and exploitation was not critical to conservation. This report, therefore, strongly recommends against the construction of moats in this region.

Electric Fence

Electric fences have been highly effective in southern and eastern Africa to control the movement of wildlife and to limit access of people to protected areas so as to reduce the illegal, uncontrolled removal of (or damage to) protected area products (*e.g.,* Butynski, 1999; Rhino Ark, 2011). Electric fences require a daily patrol to check for breakage, and a daily check of conductivity and voltage. All repairs must be made immediately. No fence is 100% effective either in controlling wildlife or people. Fences are most effective when they are consistently maintained so that all attempts to break in or out are immediately prevented. For more information concerning electric fence as a wildlife barrier and conservation tool, see pages 36 – 42.

Figure 12. Comprehensive game-proof electric fence with wire mesh at the Aberdare Conservation Area, Kenya.

Nyayo Tea Zone

Electric fences have been highly effective Tea is one of Kenya's major crops, particularly for export and the earning of foreign exchange. In 2007, tea in Kenya covered 1,410 km² (Kenya Vision 2030, 2007). There are, of course, 'costs' related to the growing of any crop. One of the costs in the case of tea in Kenya is that it is grown on land once covered by species-rich montane forest that also served as high-quality water catchment and as a source of forest products important to local people.

The Nyayo Tea Zone Development Corporation (NTZDC), received US$ 24 million from the Africa Development Bank in 1986 to clear natural forest on Kenya's Forest Reserve land to establish the Nyayo Tea Zone. Significant additional funding was later received from African Development Bank. The hope was that by clearly marking the boundary with a 100 m wide physical barrier of tea, theft and agricultural encroachment into the Forest Reserves would be discouraged, and wildlife would be prevented from leaving the Forest Reserve (Omoluabi & Coompson, 2002).

According to Wairagu (1996), "*The concept of Nyayo Tea Zone was developed by the Government in 1984 as a strategic intervention to arrest and curb further encroachment into gazetted protection forests. This goal was to be achieved through creation of tea belts to act as physical buffers between protected forests and*

surrounding communities. Also, through creation of employment and alternative sources of income, the Nyayo Tea Zones would hopefully provide an economic buffer and consequently ease off exploitation pressure on the forest." "The Corporation shall in consultation with the Chief Conservator of Forest, create as part of the forests and without excision from the forests, tea growing zones to be known as Nyayo Tea Zones in gazetted forests in those areas that the Kenya Tea Development Authority (KTDA) does not operate."

Figure 13. Tea plantation at Kiptagitch at the boundary between the South West Mau Forest Reserve and Transmara Forest Reserve, Kenya. Like all of Kenya's tea growing areas, this was once covered with species-rich montane forest. More than 1,400 km² of Kenya's montane forest has been lost to tea.

Forest Reserve from the boundary as mandated, clearance was often up to 500 m into the natural forest (*e.g.*, Aberdare), and up to 2,000 m in some places (*e.g.*, Bungoma Forest Reserve) (MENR, 1994a; IUCN, 1996). FAO (1994) concluded that *"…the objectives of increasing employment and earning foreign exchange appear to have been considered paramount with the result that areas of forest and plantation, far larger than needed for creating a protective belt, were taken over and felled by NTZDC."*

KWS has concluded that tea has limited value as a 'buffer' between natural forest and cropland. Two years after the above observations by FAO (1994) and Wairagu (1996), the Forestry Adviser, Nyayo Tea Zones Improvement and Forest Conservation Project, indicated that between 1986 and 1991, 61.5 km² of natural forest were cut as part of the Nyayo Tea Zone and that 27.0 km² (44%) were cleared but found to be unsuitable for tea. He stated that sites deemed unsuitable for tea would revert to forest. He also noted the following:

- *"Success in controlling extra-legal exploitation, grazing and other forest destruction has been quite limited mainly due to poor co-ordination with Forest Department."*

- As of 1996, no reafforestation of the 27.0 km² of cleared natural forest had been undertaken.

- *"Close to 10,000 people are currently employed by the Corporation mainly in field management. Due to various problems including uncompetitive wages, the corporation has not been able to attract labour from surrounding communities. Labour has therefore to be imported from distant places."*

As of 2016, NTZDC had established 1,300 km of buffer zone. This involved the removal of 120 km² of montane forest, of which 35 km² (29%) has been planted with tea (W. Gichunga & S. Muriithi, pers. comm.).

Figure 14. Tea plantations along the Kanunda River, on the South Western Mau Forest Reserve's 2001 excised area.

We have no figures on how much of the 120 km² area has been planted with fuelwood or remains unplanted. We do not know (nor did we ask) what happens to the wood products of the cleared montane forest (presumably lumber, poles, firewood, charcoal, *etc*), or to the wood products of NTZDC's exotic tree plantations.

As of 1992, >6 km² of montane forest in the SW Mau FR had been cleared by NTZDC. We do not know the area of montane forest that was cleared in SW Mau FR by NTZDC during the 24 years between 1992 and 2016, nor do we know how much of the cleared area has been planted with tea or exotic trees for fuelwood, nor how much remains unplanted.

During this study we were told that Nyayo Tea Zone was planted along the western and southeast edges of the SW Mau FR in areas were large tea plantations already occurred up to the boundary of the Forest Reserve, and where the forest was already well protected and under no threat. One of the questions raised by these actions of the NTZDA is, "*If an existing >1-km-wide zone of tea estate is not protecting the natural forest, is destroying the montane forest to add a 100 m wide Nyayo Tea Zone going to have a net positive impact on the conservation of the forest?*"

Although the NTZDA can be criticized for the destruction of large areas of montane forest and for not achieving all of the positive conservation impacts expected, the Nyayo Tea Zone has been effective in preventing agricultural encroachment and settlement within Forest Reserves, and thus, in securing Forest Reserve boundaries (W. Gichunga & S. Muriithi, pers. comm). While flying many times over Kenya's main water towers, C. Lambrechts (pers. comm.) has never observed agricultural encroachment or settlement where there is Nyayo Tea Zone.

During this study, people complained of receiving unfair wages and about the generally poor manner in which the Nyayo Tea Zone is run. The present situation, with its dissatisfied workers and destroyed montane forest habitat indicates that this scheme is not meeting its objectives. Next to the destruction of valuable natural forest, what is most worrying about the Nyayo Tea Zone Project is that it seems to

have not done much to help the local farmers, but rather has attracted additional people to the edge of the Forest Reserves. Many of these people, who are poorer than the resident farmers and probably landless, are now, likely, relying upon the natural forest for resources such as fuelwood and poles.

The presence of large areas of cleared montane forest for the Nyayo Tea Zone that are either not planted in tea, or which hold unproductive tea, is a great waste of (1) precious natural forest, (2) of human resources, and (3) of funds which were supposed to be used to conserve Kenya's increasingly threatened and degraded montane forests.

The actions of the Nyayo Tea Zone (1) blurs the boundary of protected areas in some places; (2) reduces the coverage of montane forest; (3) reduces the amount of forest produce available to local communities; (4) reduces the effectiveness of the watershed; and (5) invites severe criticism of the NTZDC, KFS, KWS, Government of Kenya, and those donors who promoted, supported and implemented what appears to be an ill-advised, environmentally damaging project.

The effectiveness of the Nyayo Tea Zone as a tool for conservation in Kenya has long been questioned. We are aware of only two independent evaluations of the effectiveness of the Nyayo Tea Zone as a conservation tool (FAO, 1994; Wairagu, 1996). Both evaluations were undertaken more than 20 years ago. That a more recent independent evaluation of the environmental impacts of the Nyayo Tea Zone has not been undertake is surprising given that (1) the NTZDC was established 30 years ago; (2) that >120 km² of the montane forest has been removed by the NTZDC; and (3) that a large amount of donor funds and Government of Kenya funds have been spent in support of the NTZDC. Without an independent evaluation, it is not known how effective the Nyayo Tea Zone is as a tool for the conservation of Kenya's montane forests, biodiversity, and watersheds.

There have been discussions on the planting (in 50-100 m-wide strips) of large, exotic, bamboos that grow in very dense clumps, as barriers for reducing human-wildlife conflict, for limiting access by people to protected areas, for creating jobs, and for supplying building material. There may be an opportunity along the perimeter of the SW Mau FR to run a Nyayo Bamboo Zone pilot project to assess the impact and feasibility of bamboo as a barrier. Bamboo is likely to provide a more impenetrable barrier, and to have less negative impact on the watershed and wildlife.

Other Physical Barriers

Stone walls, stock fences with hot wires, and multi-strand fences have all been used in attempts to deter wildlife movements and all have been effective against some species. None of these types of fences have, however, proven to be effective barriers against elephants or humans, the two species which the W Mau FR and SW Mau FR barrier must be able to deter.

Simple, non-electric, high tensile steel fences have been erected by KWS. These fences present the same maintenance obligations as electric fences, but have added disadvantages of being far more costly, and acting as a lethal trap to animals that get entangled.

'Live barriers' comprised of one or more species of plants have been used with some success under some circumstances. Live barriers are, however, generally not effective against elephants and primates, and are probably never effective against people. As such, they cannot be considered for

use in the W Mau FR and SW Mau FR. In addition, many of the species of plants used to develop live barriers are exotics, some of which are able to out-compete the local flora and rapidly spread, covering and degrading vast areas of natural habitat, or of pasture and cropland. *Opuntia vulqaris* and *Opuntia ficus-indica* are two such species. Other exotics are noxious and potentially dangerous to people, livestock, and wildlife. Another consideration is that Kenya has laws governing the importation and movement of exotic plants. Special permission must be obtained to import, experiment with, or otherwise use, these plants.

Conclusions

In their review of the effectiveness against elephants of nine control methods, DHVC (1992) concluded that, "*Of these methods, only electrified fences have proved effective in controlling the movement of large mammals, but this form of barrier is dependent on effective maintenance programmes and this is the key reason why they fail in a rural setting*."

As with moats, the initial costs of constructing electric fences is high, but compared to moats, the maintenance costs are low (Table 1). Moats require 0.5-1.4 maintenance people/km, while electric fences needs but 0.25 maintenance people/km. Thus, the cost of labour for maintenance of an electric fence is only 20-50% that of maintaining a moat.

In addition, fences cause less damage to the vegetation than do moats. For moats, it is preferred that the vegetation be cleared over an 18 m wide swath, while for an electric fence the preferred width is 7-10 m. Thus, the damage to the vegetation is only about half as great when constructing an electric fence as when building a moat.

A total 40.7 km of comprehensive game-proof electric fence with wire mesh is recommended for construction along the east boundary of the W Mau FR (9.0 km) and along the SW Mau FR 2001 excision boundary (32.2 km; Figure 123). Over its length, this fence changes direction only nine times. There is one straight section of 24.3 km. The terrain is mostly flat to moderately hilly, with several valleys with streams and small rivers. Relative to where electric fence has been constructed at other protected areas in Kenya (*e.g.,* Aberdare; Butynski, 1999; Rhino Ark, 2011), the terrain here is not particularly challenging for fence construction and maintenance.

Control method	Effectiveness	Environmental impact	Cost
Brush fence	low	low	low
Stone wall	low	low	medium
Vegetation barrier	low	medium	low
Moat/ditch	low	medium	high
Wooden stockade	low	low	medium
Control shooting	medium	high	high
Driving	low	low	high
Steel fence	medium	medium	high
Electric fence	high	medium	high
Tea zone	medium	high	medium

Table 1. Effectiveness, environmental impact, and cost of elephant control methods used in Kenya (based on DHVC 1992). 'Tea zone' added by Butynski and de Jong (pers. obs.).

THE SOUTH WESTERN MAU FOREST RESERVE WILDLIFE FENCE PROJECT

INTRODUCTION

The SW Mau FR has a perimeter of roughly 185 km. If the 2001 excised area is not included, the perimeter is *ca*. 125 km (Figure 15; measured with ArcGIS). Roughly 30 km of this perimeter is adjacent to tea plantations (*e.g.*, Unilever, Finlays, Kiptagitch, Nyayo Tea Zone).

The game-proof electric fence proposed for the east side of W Mau FR and SW Mau FR has a length of *ca.* 40.7 km.

COST OF ELECTRIC FENCE

At present, 1 km of comprehensive game-proof electric fence with wire mesh costs *ca.* US$ 25,000 (C. Lambrechts, pers. comm). Thus, the costs of constructing the *ca*. 40.7 km fence for the W Mau FR and SW Mau FR is estimated at US$ 1,017,500. Once construction is complete, the annual cost of maintaining 1 km of fence will be *ca.* US$ 1,000. At this rate, the annual maintenance cost of this 40.7 km fence will be *ca.* US$ 40,700. The minimum life expectancy of this fence is 20 years (C. Lambrechts, pers. comm.).

DESIGN AND CONSTRUCTION OF ELECTRIC FENCE

The electric fence for the W Mau FR - SW Mau FR should be modeled after the comprehensive game-proof electric fence with wire mesh constructed in the Aberdare, Mt. Kenya, and Eburu. This fence is of appropriate design and quality. Details of the technical aspects of the construction of the Aberdare Fence, and of power supplies to that fence, are covered in detail in FAO (1994) and elsewhere and, therefore, will not be repeated here.

Here is an overview of the design of the 'Comprehensive Game-proof Electric Fence with Wire Mesh. This is the fence design recommended for the entire length of the W Mau FR-SW Mau FR Fence (see below).

Distance between posts: 10 m

Post length: 3 m (0.9 m below ground; 2.1 m above ground)

Wire strands: eight (six live strands; two earth strands; L-L-L-E-L-L-L-E)

Wire mesh: 1.5 m wide tight lock wire mesh (0.8 m below ground; 0.7 m above ground)

Before the electric fence can be constructed, a 10 m-wide swath must be cleared of vegetation. This is needed so as to: (1) prevent primates from moving over the top of the fence through the

trees; (2) avoid making contact between the live wires and vegetation; (3) help prevent trees from falling onto the fence; and (4) allow construction of a 4 wheel-drive maintenance vehicle tract on the inside of the fence and a fire break on the outside. In the case of the W Mau FR - SW Mau FR fence, however, much of the site for the fence is over previously encroached land where few trees occur and where short-grass is the most common vegetation type.

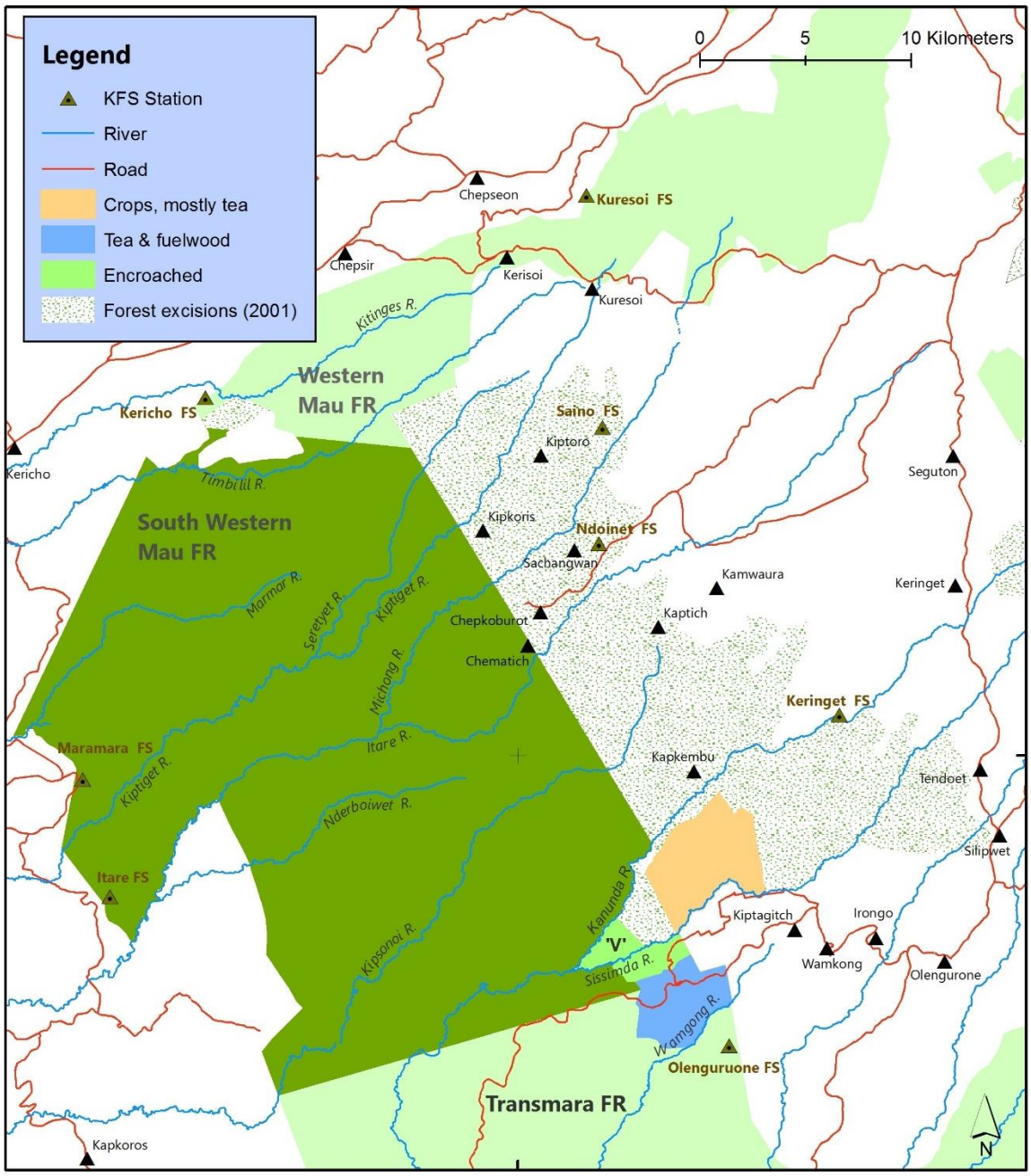


Figure 15. Western Mau Forest Reserve and the South Western Mau Forest Reserve of the Mau Forests Complex, Kenya.

POSITIVE IMPACTS OF ELECTRIC FENCE

As for the Aberdare Conservation Area and Eburu Forest Reserve, a well-built, properly monitored and maintained, game-proof electric fence along the east boundary of the W Mau FR and along the SW Mau FR 2001 excision boundary is expected to provide the following positive impacts.

- Enhance the economic welfare of the local people by protecting them and their property against injury and damage caused by wildlife. The fence will help stabilize food production, improve food security, improve crop and livestock production, increase the land area available for crop and livestock production, enhance the value of the land, and stop wildlife from destroying dams, pipes and troughs (Munai, 1991; DHVC, 1992; KIFCON, 1992; FAO, 1994; Mwathe *et al.*, 1998). In short, the fence will greatly reduce the level of human-wildlife conflict.

- Serve as a clear and effective physical barrier to agricultural encroachment, illegal removal of forest products and wildlife, and protect the integrity of the watershed, forests and other natural habitats. This will make possible the conservation of the W Mau FR and SW Mau FR ecosystem for the benefit of the present and future generations. It will also serve to create a more positive national and international image for KFS, KWS and Government of Kenya.

DHVC (1992) suggests that without an electric fence between Kenya's protected areas and adjacent high density human populations, there will be:

- An increase in the level of conflict between wildlife and people. This will lead to an increase in the hostility of people towards wildlife, and to additional political pressure to solve human-wildlife conflicts.

- A reduction, if not eradication, of wildlife populations, with valuable animals being destroyed.

- An increase in illegal activities, and in the degradation and loss of natural forest.

- An increase in the manpower and costs needed to control wildlife.

The Aberdare electric fence (Butynski, 1999; Rhino Ark, 2011) and the 'Naari Forest Reserve Electric Fence' can be used as case studies, and taken as relevant examples of what the level of benefit to the W Mau FR, SW Mau FR, and local people is likely to be once the SW Mau FR electric fence is in place.

The 22 km long Naari Forest Reserve Electric Fence was constructed on the northeast slope of Mt. Kenya during 1996-1997. This electric fence was built in ecological, human and socio-economic environments similar to those of SW Mau FR. As with the SW Mau FR fence, the main objectives of the Naari Fence are to reduce wildlife-human conflict and to protect the natural forest.

An EIA for the proposed Naari Fence was conducted in 1995 (Kaaria *et al.*, 1995). This EIA weighed the various options for resolving human-wildlife conflict (*e.g.*, such as stone walls, live barriers, enhanced problem animal control, and electric fence). The 'no project' option was also considered and

found deficient and too expensive. Construction of an electric fence was considered the best option.

In November 1997, a study was conducted to assess the social, economic and environmental impacts of this fence. The following quote is taken from the Executive Summary of the report on this study (Mwathe *et al.*, 1998).

"The study shows that environmental impacts were minimum while most of the socio-economic impacts were positive:

The amount of land under cultivation in Naari has increased by 18 per cent while crop diversity has increased by 42 per cent. Cultivation of tomatoes, bananas, sugar cane and sweet potatoes has increased by over 80 per cent.

The fence has decreased forest access. The attendance in adult education classes also decreased as more adults, mainly women, engaged in other economic activities, especially farming. However, these seemingly negative impacts are viewed as trade-offs against the accruing benefits of the fence.

There is overwhelming evidence that the people of Naari now spend less time guarding crops; have doubled their economic activities, have more accommodating attitudes of KWS than before and suffer less crop and property damage. Number of reported cases of human-wildlife conflict dropped by 86 per cent. However, these positive attitudes are watered down by the continued destruction of Imenti forest through illegal logging, burning etc.

Farmers who cultivate inside the forest under the Nonresidential Shamba System have experienced more crop damage. It is suggested that the Shamba System be done away with as it is neither beneficial to forest conservation nor increasing food security.

On fence effectiveness, voltage records indicate an average of 7.2 kilovolts. This is a sign of a well maintained fence. However, there are many worrying cases of human vandalism, which cast doubt on people's seriousness in the whole project. More community sensitization should help fill the gap in awareness.

This study concludes that Naari Fence is a premier KWS community project that has scored highly in providing benefits within a short time, with few discernible negative environmental impacts."

NEGATIVE IMPACTS OF ELECTRIC FENCE

Reports by Munai (1991), DHVC (1992), FAO (1994, 1997) and Ngoru (1998) suggest that a well-built, properly monitored and maintained, game-proof electric fence along the east boundary of the W Mau FR and along the SW Mau FR 2001 excision boundary would, or could, have the following negative impacts:

- High construction and maintenance costs.
- Local communities may be denied access to natural resources, including wildlife.

- Free movement of animals is limited, affecting migration routes and dispersal, and leading to reduced range size and destruction of habitat. This, in turn, might disrupt the balance of the ecological community and lead to habitat degradation and loss of biodiversity.
- Increased 'island effect'.
- Exotic tree plantations will receive increased damage from wildlife.
- Increased erosion and an 'eye-sore' on the scenery.

While these concerns should be expressed, this report has serious problems with this listing, and sees only the high costs of fence construction and maintenance as a 'true negative' here. In other words, except for the high costs, these concerns are not of particular relevance to the question of whether or not a fence should be placed along the east boundary of the W Mau FR and along the SW Mau FR 2001 excision boundary. This report argues that the above suggested negative conditions and trends have already been put into place by the exploitive activities of the local people and that the fence, instead of creating or enhancing these negative conditions and trends, will slow, stop or reverse them.

A good, hard, realistic look at the situation on the ground indicates the following:

- People have already destroyed a large portion of the former natural forest resource base of the W Mau FR and SW Mau FR, indeed, most of the forested area is no under settlement and agriculture. Without the fence, all natural forest is likely to be destroyed, forever 'denying' people of this important resource and the opportunities for sustainable use and development that it now offers. The fence gives the local people the hope of a future in which natural forest products will continue to be available to them and their children. It also gives them the opportunity to participate in the management of this resource and to help stop its destruction by a relative few.

- The SW Mau FR is already essentially an isolated island ecosystem given its tenuous connection to the rest of the Mau Forests Complex via a narrow (*ca.* 1.8 km wide), degraded, corridor of exotic tree plantation at the south end of the W Mau FR, and the near complete destruction of natural habitats all along its perimeter by farmers, loggers, and others (Figures 3 & 15). While an electric fence serves as a barrier for a few dozen of the larger species of mammal, this impact does not compare with that of the barrier erected by the loss of habitat over vast areas and by the dense human settlement. Thousands of species of plants and animals that have no problem moving through or over an electric fence are today already prevented from moving in and out of the W Mau FR and SW Mau FR simply because there is no suitable habitat to move through. Thus, the free movement of animals in this region is already extremely limited, migration and dispersal routes already blocked, ranges already reduced, and suitable habitat already destroyed as a result of past and current human activities. These negative activities are likely to continue in a major way unless an effective fence is put in place.

- Thousands of species of plants and animals in the W Mau FR and SW Mau FR are today in greatly diminished populations living over much reduced ranges, not because of a fence, but because a large part of the suitable habitat over their former geographical ranges has been degraded or destroyed by people. People have already made an 'island' of these Forest

Reserves and the 'island effect' is already at work. All evidence suggests that without the fence, 'Mau Forest Island' will become yet smaller and the island effect yet greater.

- There is much concern, and much has been said, about possible inbreeding depression in small populations of wild species. At this time, most species of plants and animals in the SW Mau FR probably have enough habitat in which to maintain adequate populations. Several species of larger mammals are at risk, however,--if not already extirpated. Black rhinoceros *Diceros bicornis* has been extirpated, African golden cat has not been documented for more than 70 years, bongo probably numbers fewer than 20 individuals, and buffalo is localized and scarce. These species, and others, have been extirpated or reduced to low numbers not as a result of a fence, but rather because no fence was in place to minimize habitat loss and poaching.

- The species which will probably be most affected by the fence is the elephant. While the fence should greatly reduce not only the level of conflict between elephants and local people, it should also reduce the frequency at which elephants are harassed and killed. The fence is expected to also, however, further limit the regular seasonal movement of elephants into (dry season) and out of (wet season) the SW Mau FR. Historically, elephants probably moved in all directions into and out of the SW Mau FR, but nearly all of these routes have been effectively blocked by loss of suitable habitat and by human settlement. The one route which remains in some use is the one which connects the SW Mau to the Mara, but the connectivity here is also under serious threat.

- The placement of the wildlife fence, as recommended in this report, will reduce damage to plantations of exotic tree outside of the fence. While exotic tree plantations within the W Mau FR, are expected to receive increased damage from wildlife, these plantations are already unproductive and uneconomical. They also appear to be the focus of illegal activities (*e.g.,* firewood collection). Some, perhaps most, have been harvested and not replanted, while others are unpruned, unthinned, and, generally, unmanaged.

- While clearing of the fence-line and construction of the fence will lead to increased erosion, and the fence is an unnatural feature placed upon the landscape, neither negative effect has any significance when compared to current levels of erosion as a result of widespread and intensive agricultural and grazing practices within and around the W Mau FR and SW Mau FR, or loss of natural scenery due to agriculture, settlement, clear-cutting, roads, *etc.* On balance, the fence will save far more soil and natural scenery than it will destroy.

COMMENTS ON THE FENCE

All people concerned with the W Mau FR-SW Mau FR fence must fairly evaluate the damage the fence will likely cause against the damage that will continue to occur if the fence is not put in place. When all is weighed and evaluated, the proposed fence for the W Mau FR–SW Mau FR is expected to be a very positive and much needed conservation tool.

Once the above questions and concerns over the fence are put into perspective, there are really but three big questions as concerns this fence. First, 'Can the funds be found to cover the substantial costs of the fence?' Second, 'Can the funds and community support needed to properly protect and maintain the fence over the long-term be found?' Third, 'Is there the necessary political support for the fence?'

While addressing these three questions lies outside the terms of reference of this study, it is clear that adequate funds, community support, and political support for the Aberdare Fence, Mt. Kenya Fence, and Eburu Fence were found. There is no reason to think that similar funds and support cannot be obtained for the W. Mau FR-SW Mau FR Fence. Observation made in the field during this study strongly indicated that the funds, and the community and political support for the W Mau FR-SW Mau FR Fence must be found if this ecosystem is to be saved and given a chance to recuperate. While the time, effort and money involved in seeing the necessary fence constructed and then maintained seem enormous, the people and the nation will be repaid many times over with the benefits obtained. The local people, KFS, KWS, local authorities, elected leaders, and donors must all come to realize this, and then to work together to construct and maintain this fence. Simply put, the costs of not fencing far outweigh the costs of fencing. The water alone from this large watershed, if protected, must be worth many time the cost of this fence.

FENCING POLICY, GUIDE-LINES AND OTHER CONSIDERATIONS

KENYA FOREST SERVICE POLICY GUIDE-LINES ON FENCING IN FOREST RESERVES

According to KFS guidelines for the placement of wildlife fences within Forest Reserves (Manegene *et al.*, 1996):

- Where plantations occur, the fence should be constructed between the indigenous forest and the plantation when feasible;
- Place the fence in an area accessible for construction and maintenance;
- Avoid placing the fence on very steep slopes;
- The fence should be as short as possible but protect as much plantation forest as possible;
- Strive to fence-in important wildlife habitats such as salt licks, water points and open glades;
- Avoid creating narrow strips of land (peninsulas) between fence-lines;
- Avoid clearing indigenous forest;
- The fence should be visible both to humans and animals to prevent accidental injuries and breakage of the fence;
- Provide access gates so that adjacent communities may obtain forest products;
- The fence should facilitate management of the forest estate.

PRIMARY CONSIDERATIONS FOR PLACEMENT OF THE FENCE AND GATES

In making decisions on where to place a game-proof fence, a large number of factors must be taken into consideration. The recommendations made in this report for placement of the W Mau FR-SW Mau FR fence were made in an attempt to minimize a number of factors, while taking into consideration KFS's Policy Guide-lines on Fencing in Forest Reserves (Manegene *et al.*, 1996). These factors are listed here in order of priority of consideration:

- Minimize the numbers of wild animals and the amount of natural habitat excluded from the area within the fence. In other words, the fence should be placed to include as much of the natural ecosystem of the W Mau FR and SW Mau FR as possible.

- Minimize both the monetary and environmental costs of constructing and maintaining the fence. These costs are affected by the following:

- Length: Short fences cost less money and do less damage to the environment than long fences.

- Terrain: The more gentle (flat) the terrain the lower the financial costs and the lower the negative impact on the ecosystem.

- Distance from roads and settlements: The more remote the fence the higher the monetary costs and the greater the negative impact on the environment. As a rule, the deeper into the W Mau FR and SW Mau FR the fence is located the steeper and more rugged the terrain, and the more difficult the logistics. Thus, building the fence on the edge of these Forest Reserves minimizes costs, problems and environmental damage.

- Gates: The larger the number of access gates the higher the costs.

- Minimize the area of 'perimeter plantation' within the fence. 'Perimeter plantations' are those which lie on the outer edge of the Forest Reserves. This Guideline does not apply as concerns the W Mau FR-SW Mau FR as there are no perimeter plantations near the proposed fence-line.

- Minimize the area of 'enclosed plantation' that lies outside of the fence. 'Enclosed plantations' are those which are completely, or nearly completely surrounded by natural forest. In the present study area, there is but one enclosed plantation. This is in the southeast corner of the W Mau FR. To not include enclose this plantation within the fenced area would be extremely expensive and would create insurmountable management problems, defeating much of the purpose of the fence. It would not be cost effective to protect this plantation from wildlife or to control access to it (and to the surrounding natural forest). The one enclosed plantation does not serve as a buffer zone either to the fence or to the natural forest. In fact, it does quite the opposite by promoting a high level of human activity and disturbance within the W Mau FR. The one enclosed plantation, most of which is already unproductive, should have its poles and timber culled, and the land either (1) abandoned to gradually revert to natural forest or, better, (2) enriched with indigenous trees to speed the process back to natural forest.

- Minimize the number of gates (KIFCON, 1992). Gates are expensive to construct and are particularly costly to effectively control. On–the-other-hand, it will be financially, politically, and environmentally costly if people are not provided with fair and ready access to those natural resources within the W Mau FR and SW Mau FR which can be legally and sustainably exploited. While this report makes recommendations as to the number and location of gates, it is extremely important that this issue be openly and thoroughly discussed with the local communities prior to construction. Since community involvement and support of the fence is

critical to the success of the fence, and since local communities are often anxious to continue to have access to products from the natural forest, KFS and KWS might use the number and location of gates as a 'bargaining chip in negotiations with local communities as concerns the role of the local community in fence maintenance and control of use of forest products.

- Minimize costs by ensuring that the fence design is right at every site. For example, there is no point putting a comprehensive game-proof electric fence with underground mesh wire between a plantation forest and the indigenous forest, as there are burrowing animals on both sides of the fence. A comprehensive game-proof electric fence is only cost-effective where placed next to communities, whereas two strand electric fences work well between plantation forest and natural forest.

THE FENCE AND LOCAL COMMUNITIES

FAO (1994), in its review of approaches to the control of wildlife in Kenya, concluded "...*that near to a suitable wildlife habitat, planning of protection measures should aim at creating an animal density gradient between wilderness and dense settlements, and that barriers or protection measures will not be successful in the long run without the involvement of the local communities. The steepest density gradient, which is an electric fence, is often the only option left where the interface between human activities and wildlife or forest reserve does not allow for the necessary buffer zones. Nevertheless, the long term sustainability of the fence is fully dependent on a high standard of maintenance and on the respect of the infrastructure by the communities. The latter is essential and requires both an attitudinal and an institutional change. The perception of wildlife by the people needs to be changed, or at least softened, through a closer involvement of the local communities in the management of the protection system and in the economic benefits to be derived from wildlife in general. Institutional changes will require that communities can enter into specific agreements with KWS and Forest Department regarding their rights to enter the protected area, to export various commodities and to co-manage some of the wildlife activities and benefits. Forest protection will require the visualization of the recognized boundary through some form of barrier, as access to the forest will have to be limited and controlled via pre-determined gates and access roads. This can only be achieved through a physical barrier, be it a moat or a fence*."

Without the collaborative support of forest-adjacent communities for the fence and its maintenance, it is unlikely that the integrity of the fence can be sustained over the long-term. Communities, therefore, need to collaborate with KFS and KWS as active partners on the construction and maintenance of the fence, and under the belief that the fence is beneficial to both the short- and the long-term well-being of the local community. KFS and KWS, on-the-other-hand, must recognize the needs of people in forest-adjacent communities who are partly or entirely dependent upon forest products. Forest-adjacent communities require support to (1) achieve a position from where it is in their own interest to contribute to the management and protection of wildlife and forest through the controlled use of forest products, and (2) develop alternate sources of income and subsistence materials outside of the forest.

A major objective of the W Mau FR-SW Mar FR Wildlife Fence Project should be to help ensure that local communities are directly involved in negotiating fence maintenance agreements and access to the Forest Reserves, and that most, if not all, of the casual labourers for fence construction and maintenance are hired from local communities. In the end, local residents must be convinced that the fence is theirs, so that its maintenance and policing become part of their daily concerns and activities.

Figure 16. People living near the South Western Mau Forest Reserve's 2001 excision boundary.

RECOMMENDATIONS AND MITIGATION MEASURES FOR FENCING

PRIORITY AREAS FOR CONSTRUCTION OF THE ELECTRIC FENCE

Phasing of the construction of a game-proof fence is necessary for the project to first gain sufficient experience with community involvement and to provide time for local concerns to be addressed and queries settled (FAO, 1994; Butynski, 1999). As such, this study of the proposed W Mau FR-SW Mau FR fence-line collected information on three pre-determined 'sections' of land. Based upon the findings of this study, the priority area for fence construction is at the north end of Section 1. Section 1 begins 1.3 km north of the Timbilil River at S 00.32720; E 35.47933; 2,360 m asl. The forest along the Timbilil River, although much degraded, remains of high conservation both for its biodiversity and its water catchment value. At this time, however, this is the most threatened site in the study area. In particularly, this site is the current focus of charcoal-makers. KFS should give this area priority at this time for its law enforcement activities so that no further damage is caused while this area awaits fence construction.

After the fence along Section 1 is constructed, the fence over Sections 2 and 3 should be built from north to south. Fence construction terminates at the end of Section 3 at S 00.59304; E 35.57728; 2437 m asl. This is the south end of the SW Mau FR 2001 excision boundary line, as well as the site where the excision boundary meets the Transmara FR.

MITIGATION MEASURES

Introduction

Discussed here are a number of mitigation measures that, if implemented, would either enhance the beneficial impacts of the wildlife fence or reduce the negative impacts of the fence. All of these activities will benefit all three sections of the fence and, therefore, should be broadly applied.

Communities Help More with Fence Maintenance

Long-term proper maintenance of the fence is probably the biggest problem and challenge faced by the W Mau FR-SW Mau FR Wildlife Fence Project. Proper fence maintenance is of benefit to all parties concerned, most particularly the local communities. The long-term success of the fence requires the support and involvement of the local communities in fence maintenance. Mechanisms need to be found whereby these communities become willing partners in fence monitoring and maintenance. Local communities can assist by clearing vegetation along the outside of the fence-line (which is an alternative to the use of herbicides) and especially by discouraging poaching, theft of fence materials, vandalism of the fence, and the illegal taking of forest products. The more the local people are consulted prior to construction of the fence, and the more they participate in the construction of the fence, the more likely they will support and assist with the long-term maintenance of the fence.

There should be formal agreements between KWS and local communities for assistance from the local communities for maintenance of the W Mau FR-SW Mau FR Wildlife Fence. These must clearly specify and detail the obligations of KWS, of KWS, and of local communities in fence construction and maintenance.

Fences should be built with support of selected members of neighbouring communities. Fence maintenance technicians should be selected from among those who worked best during fence construction. After initial training in fence maintenance, these technicians will undergo training to refresh and upgrade their knowledge.

Fence construction and maintenance must both be seen as 'partnership activities'. It is vital for the success of the fence that local communities recognize this fact prior to fence construction and that they participate as true partners in fence construction and maintenance right from the beginning.

Change Local Community Attitudes Toward Forest Use

Local communities should understand the principle of 'sustainable utilization' and come to realize that the amount of forest resource that is allowed to be taken from Forest Reserves is guided by this principle. They should also be aware that as the natural forest of the W Mau FR and SW Mau FR recover their former conservation values, the amount of forest product that they will be permitted to remove is likely to increase. For example, as the population of large timber trees recovers, pit-sawing may once again become a legal activity. It should also be made clear to the local communities that these Forest Reserves are a vital national asset, and that access to this area, and particularly the taking of forest products, is a 'privilege' not granted to all Kenyans--and not a 'right'. This important distinction should, of course, be made with as much diplomacy as possible. They should also be clear as to 'rules of access', and understand that if the 'privilege' of access is abused, the gate will be temporarily closed or the allowable take of forest resource further restricted.

Consult Communities about Location of Gates

KFS and KWS need to consult closely with local communities concerning the locations of pedestrian gates. Although the number of pedestrian gates recommended in this report should be adequate, the exact position of the gates might vary somewhat from that suggested here. In some places, firewood and grazing are the most important resource that people obtain from the W Mau FR and SW Mau FR.

Improve Manning of Gates

Pedestrian gates should be closely monitored to see if they are properly used and if they meet the needs of the local people. KFS, KWS, and the local authorities need to ensure that all gates are continuously and effectively manned when open for public access. Like the fence itself, the proper manning of gates is of benefit to all except those who would conduct illegal acts within the W Mau FR and SW Mau FR. All parties must make a concerted effort to consistently enforce regulations governing access and the taking of forest products. This will help reduce misunderstandings, mixed-messages, and abuses of the system. The access gate and fence maintenance strategies now applied to the Aberdare, Mt. Kenya, and Eburu fences can probably be adopted for the W Mau FR-SW Mau FR Wildlife Fence.

Maintain the Fence Manually

On steep slopes the fence-line should be cleared manually. Maintenance of the fence-line should also be done manually and without the use of herbicides.

Limit Fence Perimeter Roads

As recommended by FAO (1997), maintenance of the fence should be undertaken on foot. In the case of the W Mau FR-SW Mau FR Wildlife Fence, there is no need for a permanent perimeter road. Not having a road will reduce damage to the environment (particularly erosion) and costs.

Limit Rate of Fence-line Clearance

To avoid the mistake made elsewhere when construction an electric fence (*e.g.,* Aberdare; Butynski, 1999), the fence-line should not be cleared for a distance of more than 5 km ahead of the constructed fence. This will help avoid or reduce a number of problems, including soil erosion and an increase in the illegal taking of forest products.

Give Fence Maintenance Priority over Fence Construction

The importance of a high standard of fence maintenance is stressed throughout this report. When a break in a wildlife fence is not quickly repaired, a series of negative events can be expected to occur; the fence becomes ineffective, local people and politicians become disillusioned with the fence, and the fence becomes damaged over its entire length both by people stealing fencing materials and by large mammals creating additional breaks. This can be extremely costly in terms of money, politics and wildlife conservation. This happened in the mid-1990s to the electric fence around Lake Nakuru National Park. Poor maintenance of a well-established fence lead to its rapid destruction. A new fence had to be constructed at great considerable cost.

It is imperative, therefore, that priority be given to fence maintenance over fence construction. If funds, materials or manpower are in short supply, it should be the policy of KFS and KWS (and clearly stated in the W Mau FR-SW Mau FR Wildlife Fence Maintenance Strategy) that priority for these resources goes to fence maintenance at the expense of new construction.

Establish Trust Fund to Support Fence Maintenance

No matter how much assistance to the maintenance of the fence is provided by the local communities, there will still be a need for considerable financial support for fence maintenance over the long-term. The current estimate is that it will cost US$ 1,000/km/year to maintain the W Mau FR-SW Mau FR Wildlife Fence, or a total of US$ 40,700/year to maintain this entire 40.7 km-long fence. This may at first seem like a great amount of money for a wildlife fence…particularly for a developing nation. Upon deeper examination, however, this fence must be seen as a financial 'bargain' as it will (1) protect from unsustainable exploitation a natural resource upon which the well-being of a nation and many million people depend, as well as (2) protect hundreds of thousands of people and their crops, livestock, and other property from damage by wildlife.

It should also be noted that at least one-third of the money for fence maintenance will go directly to the local economies. This will be largely in the form of salaries to 10 fence maintenance workers (one per 4 km of fence) and one supervisor, and equipment (including one motorbike). This alone would bring an estimated US$ 13,400/year into the local economy. This is not an insignificant sum given the low incomes of people in these communities.

The most obvious approach for guaranteeing long-term funding for the maintenance of this fence is to establish a 'W Mau FR-SW Mau FR Wildlife Fence Trust Fund'. To safely generate US$ 40,700/year, the principle of this fund needs to be *ca.* US$ 582,000 – 814,000 (using an annual rate of return on investment of between 5% and 7%). Thus, the principle required for the trust fund for maintenance of the fence is about two-thirds of what it will cost to construct the fence. Trust funds for financing conservation activities are becoming increasingly common and popular. Major international donors now appear interested in contributing funds to the principle of properly set-up conservation trust funds. For example, in Uganda, the 'Mgahinga and Bwindi-Impenetrable Forests Conservation Trust was established in 1994 and now has a principle of USS 6,200,000. That trust fund was set-up with assistance and financial support from the World Bank GEF, USAID and other donors.

In the case of the 'W Mau FR-SW Mau FR Wildlife Fence Trust Fund' it should be possible to obtain funds from numerous sources, particularly those that are themselves dependent on the flow of ample water from these two Forest Reserves. Once people are fully aware of the importance of this watershed to their well-being and that of their families, businesses, and industries, it should be possible to obtain funds for the Trust from many sources over the vast area that receives water from the watershed that these Forest Reserves protect. Another possibility might be to increase the cost of water and to use funds generated by this increase to establish the principal of the Trust. It should also be remembered that the W Mau FR and SW Mau FR hold an important biodiversity that includes threatened taxa such as elephant and bongo. As such, funds for the Trust might be available from a number of the many organizations and aid agencies interested in elephant, bongo and biodiversity conservation.

Develop a Fence Maintenance Strategy

The cost of maintaining a kilometre of wildlife fence in W Mau FR and SW Mau FR is now estimated to be US$ 1,000/year. Therefore, the annual maintenance cost of this fence is today roughly US$ 40,700. As stressed above, maintenance of the fence is critical to the success of the fencing programme, as well as to the security of these two Forest Reserves. A strategy for maintaining the fence needs to be developed and tested so that (1) there are always funds, materials, and people at hand to maintain the fence, and so that (2) everyone involved with fence maintenance (KFS, KWS and local people) clearly understands his/her role in the process of maintaining the fence.

KFS and KWS now have considerable experience with developing strategies for the maintenance of electric fences around protected areas. This involves training of local fence maintenance technicians by KWS fencing specialists, and the establishment of the managerial and administrative structures necessary for good fence maintenance (Masinde, 1998). The '*Western Mau Forest Reserve and South Western Mau Forest Reserve Wildlife Fence Maintenance Strategy*' should be drafted by those most experienced with fence maintenance issues and problems. The draft strategy should then be discussed among KFS, KWS, and local stakeholders during a series of workshops specifically organized for this purpose. The development of the strategy should be an on-going activity. This is because valuable lessons will be learned with time, and because conditions both in the field and at the responsible institutions will also change with time. Once an effective strategy is in place, financial support for the maintenance of the fence should be easier to obtain, including donor support for the '*Western Mau Forest Reserve and South Western Mau Forest Reserve Wildlife Fence Trust Fund*'.

The strategy should comprise the development of a simple, but thorough, *'Western Mau Forest Reserve and South Western Mau Forest Reserve Wildlife Fence Maintenance Manual'* to guide local fence maintenance personnel, making it clear to them what they should and should not do as concerns fence maintenance, how to maintain and submit their records, who they contact if they have problems or need materials, *etc.*

Conduct More Research on Wildlife Barriers

There is no doubt that electric fence is the best barrier available at this time for reducing the conflict between wildlife and people, and for controlling access of people to natural forest. Research on electric fencing and other wildlife barriers needs to be promoted and expanded so that less expensive, more effective, more reliable, more environmentally friendly, and easier to construct and maintain barriers can be developed. While it is probable that the major advances in wildlife barriers over the coming decade will involve electric fencing, new innovations are expected to emerge. Some of these may prove to be superior to electric fencing over the longer term…at least under some circumstances.

Promote Out-of-Forest Conservation

Dependence on wood for fuel and as a building material is placing enormous strain on the W Mau FR and SW Mau FR. If people were encouraged to cultivate more trees on their own land they could, in time, be self-sustaining in regard to fuel and lumber, and those with a surplus could generate income. Fuel efficient stoves would, of course, also contribute to this effort. The costs of supplying these units, and of the workshops needed to teach the local people how to use them, would probably be negligible compared to the long-term benefits both to the community and to the Forest Reserves.

Provide More Conservation Education to Communities

A strong campaign for community awareness and conservation education would help the local people to better understand and appreciate the importance of protecting and sustainably using the W Mau FR and SW Mau FR. Community workshops, education seminars, and grievance meetings should be organized by KFS, KWS, and local authorities to familiarize members of the community with these two Forest Reserves and the issues involved in their long-term conservation. Shifting from the unrestrained taking of a seemingly endless supply of forest products to the sustainable use of a protected ecosystem will not be an easy transition for those people living in the most densely populated areas near the wildlife fence. Awareness of the importance of these resources, together with proper enforcement of the regulations, will help to change perceptions and reduce the use of the protected area. It is also necessary, however, to alter people's inefficient and unsustainable practices at home in order to adequately reduce dependence on the Forest Reserves.

Improve Law Enforcement

Law enforcement is wanting on the part of KFS and KWS in the W Mau FR and SW Mau FR. Not enforcing laws governing the taking of forest products or the use of Forest Reserve land has led to (1) over- utilization, degradation and loss of natural forest in both Forest Reserves, (2) damage to the watershed, and (3) decline of public and donor confidence in KFS and KWS. One of the primary goals of the W Mau FR and SW Mau FR Fence Maintenance Strategy must be to ensure that KFS and KWS meet the challenges for effective law enforcement that these two Forest Reserves presents.

Remove Encroachers

Agricultural encroachers now have a strong foot-hold in many of Kenya's Forest Reserves, and large areas of Forest Reserve land have been given over to encroachers. At the south end of Sector 3 of the proposed W Mau FR-SW Mau FR Wildlife Fence there is an area of encroachment known as the 'V' (Figure 15). As observed again and again, these encroachers will expand their operations and further destroy the conservation values of the SW Mau FR--as long as they are allowed to do so. For the good of Kenya, Kenyans, and the SW Mau FR, all encroachers should be removed from the west of the 2001 excision boundary. This may require action by the highest levels of Government. None of the encroached upon areas be excised from the Forest Reserve. Past excisions of large areas of the SW Mau FR have already greatly damaged this watershed and the conservation values of this Forest Reserve (see above). To allow a tiny part of Kenya's population to illegally destroy vital natural resources that are protected under law for the common good, undermines the future of the nation and of this Forest Reserve. The wildlife fence, together with a number of concomitant conservation activities can prevent reinvasion of the SW Mau FR by encroachers.

Removal of the encroachers from the SW Mau FR will require that KFS and KWS work closely with local communities and other government authorities to ensure that the encroachers experience minimal hardship, and that all parties understand why this action is necessary. As much diplomacy as possible should be used in order to minimize negative public opinion towards KFS and KWS, as well as towards the wildlife fence. Probably the best way to minimize hardship for the encroachers is to provide as many of them as possible with jobs such as the planting and caring of indigenous tree seedlings within the Forest Reserves, and construction and maintenance of the fence. All of these activities are good for the conservation of the Forest Reserves, for the employed encroachers and their families, for the local communities, and for Kenya as a whole. These are activities which KFS should focus much of its attention and resources on as they help all interested parties and provide both immediate and long-term benefits.

Minimize Soil Erosion

Soil erosion along the fence-line needs to be minimized both during and after fence construction. Although much of the bare ground created by fence construction will eventually be covered by a dense mat of short grass and forbs, this can take several years to occur. In the meantime, the fence-line should be planted with Kikuyu grass and other suitable grass species. This should be done as soon as the fence-line is cleared as considerable erosion and gullying can occur prior to the construction of the fence. This rehabilitation work should be monitored until completed as, in some cases, replanting and other measures may be necessary to ensure that the required protection has been provided. Limiting use of the new fence-line by vehicles and livestock will also do much to minimize soil erosion.

Conduct More Research on Elephants

Elephants are a keystone species in the W Mau FR and SW Mau FR. They are also a significant tourist attraction and major problem animal for neighbouring farms. In order to better manage elephants in an increasingly confined and ever smaller ecosystem, much more needs to be known about them, particularly about those aspects of their population and socioecology that have strong implications for management. These include research on population size and structure, movement patterns, and food habits. Monitoring by satellite of the movement of radio collared elephants, as is now being done in many regions of Kenya, would be a most worthwhile research undertaking in these two Forest Reserves.

Figure 17. Elephants *Loxodonta africana* are both a 'flagship species' and a 'keystone species' for the Western Mau Forest Reserve and South Western Mau Forest Reserve, Kenya.

Promote Ecotourism

Ecotourism, particularly community-based ecotourism, should be promoted within and around the SW Mau FR. Such programs will benefit all parties concerned, but most importantly they will bring additional income to local communities and make the local people more aware of the link between their well-being and that of the SW Mau FR.

DESCRIPTION OF THE PROJECT AREA

CHRONOLOGY OF FOREST LOSS IN THE MAU FORESTS COMPLEX

During 2001-2013, Kenya lost 2,377 km² of forest and gained 1,004 km² of forest. The net loss was 1,373 km². It should be noted, however, that most of the loss was likely due to the removal of natural forest, while most of the 'gain' was likely due to the planting of tea and of other exotic tree plantations. Little of the gain would have been due to an increase in the extent of natural forest.

The total extent of 'forest cover' (*i.e.*, closed canopy forest + woodland) in Kenya in 2012 was *ca.* 33,177 km². This is only *ca*. 6% of Kenya's surface area. The area of 'closed canopy forest' in 1995 was 9,840 km², or but 1.7% of Kenya's land area (UNEP, 2001). This compares to 9.3% for the average African country (Spruyt, 2011). The average area of closed canopy forest in Kenya has continued to decline since 1995 (WRI, 2007). The internationally recommended forest cover (closed canopy + woodland) is 10% (Kenya Vision 2030, 2007; Gichuru, 2015; Sang, 2001). The Kenya constitutional requirement is 10% forest cover (Kenya Forest Policy, 2014). Kenya's goal is to achieve 10% forest cover by 2030 (Kenya Vision 20130, 2007).

Based on altitude and rainfall, we estimate that the forests of the Mau Escarpment covered >8,000 km² in the 1800s, and that, today, this forest (*i.e.*, the Mau Forests Complex) has been reduced by >60%. The Mau Forests Complex (Figure 3) is comprised of 21 Forest Reserves and one Trust Land Forest. In 1991, the Mau Forest Complex was *ca.* 4,160 km². In 2001, 616 km² of the Mau Forests Complex was excised and, since 1991, another *ca.* 406 km² lost to settlements and encroachment (SMCA, 2016). In 2009, 190 km² of encroached, largely deforested, land in the SW Mau FR were repossessed. Since 2009, encroachment, degradation, and fragmentation of the *ca.* 3,120 km² of the Mau Forests Complex that remains has continued in spite of the considerable national and international efforts and resources that have been provided for the protection, better management, and rehabilitation of the Mau Forests Complex (Obati & Breckling, 2015). These include the raising of millions of tree seedlings, the addition of 190 law enforcement officials, and the establishment of several bodies to lead rehabilitation efforts (*e.g.*, 'Task Forest on the Conservation of the Mau Forests Complex', 'Interim Coordinating Secretariat', 'Mau Forest Rehabilitation Programme', 'Save the Mau Trust Fund', Committee on Rehabilitation and Livelihoods', 'Joint Enforcement Unit', 'Kenya Water Towers Agency', and 'Water Towers Conservation Fund'; RMFC, 2010; SMCA, 2016).

A report by by the multi-stakeholder Task Force on the Conservation of the Mau Forests Complex on the way forward for dealing with the crisis in the Mau Forests Complex was endorsed by Cabinet in July 2009 and by Parliament in September 2009 (SMCA, 2016). This report recommendations the following:

Management

- *The biodiversity hotspots and critical catchments areas should be secured;*
- *The security of all indigenous forests should be reinforced to sustain water supply;*
- *The conservation status of the Mau Forests Complex should be upgraded to take into consideration its critical role as a natural asset of national, regional and international importance;*
- *Synergies and strong partnership should be established among key stakeholders in the Mau Forests Complex, including Government ministries, in order to help achieve the conservation of the Mau Forests Complex;*

Boundaries

- *The boundaries of the Mau Forests Complex should be secured and title deeds issued for 21 forest reserves, and the Maasai Mau Trust Land Forest;*
- *The Government needs to examine the most appropriate approaches for securing the Mau Forests Complex boundaries;*

Restoration

- *All critical water catchments should be restored using enrichment planting, natural regeneration and other appropriate means;*

Livelihoods

- *Participatory forest management should be fast-tracked to enhance the livelihoods of forest adjacent communities. They should be involved in afforestation and reforestation, among others;*
- *Value addition to forest products should be promoted;*
- *On farm forestry should be encouraged to reduce forest degradation and dependence on forest products; and,*
- *Benefits arising from payment for environmental services should also accrue to the adjacent communities involved in forest conservation.*

The 190-km² area in the SW Mau FR that was repossessed in 2009 was severely damaged by encroachers and now has little forest cover. At this time, this is essentially a livestock grazing and browsing area that also continues to suffer from an unsustainable level of exploitation of forest products. The impacts of efforts since 2009 to rehabilitate these 190 km², or to bring them under sustainable use, are not obvious. Those projects appear to have failed.

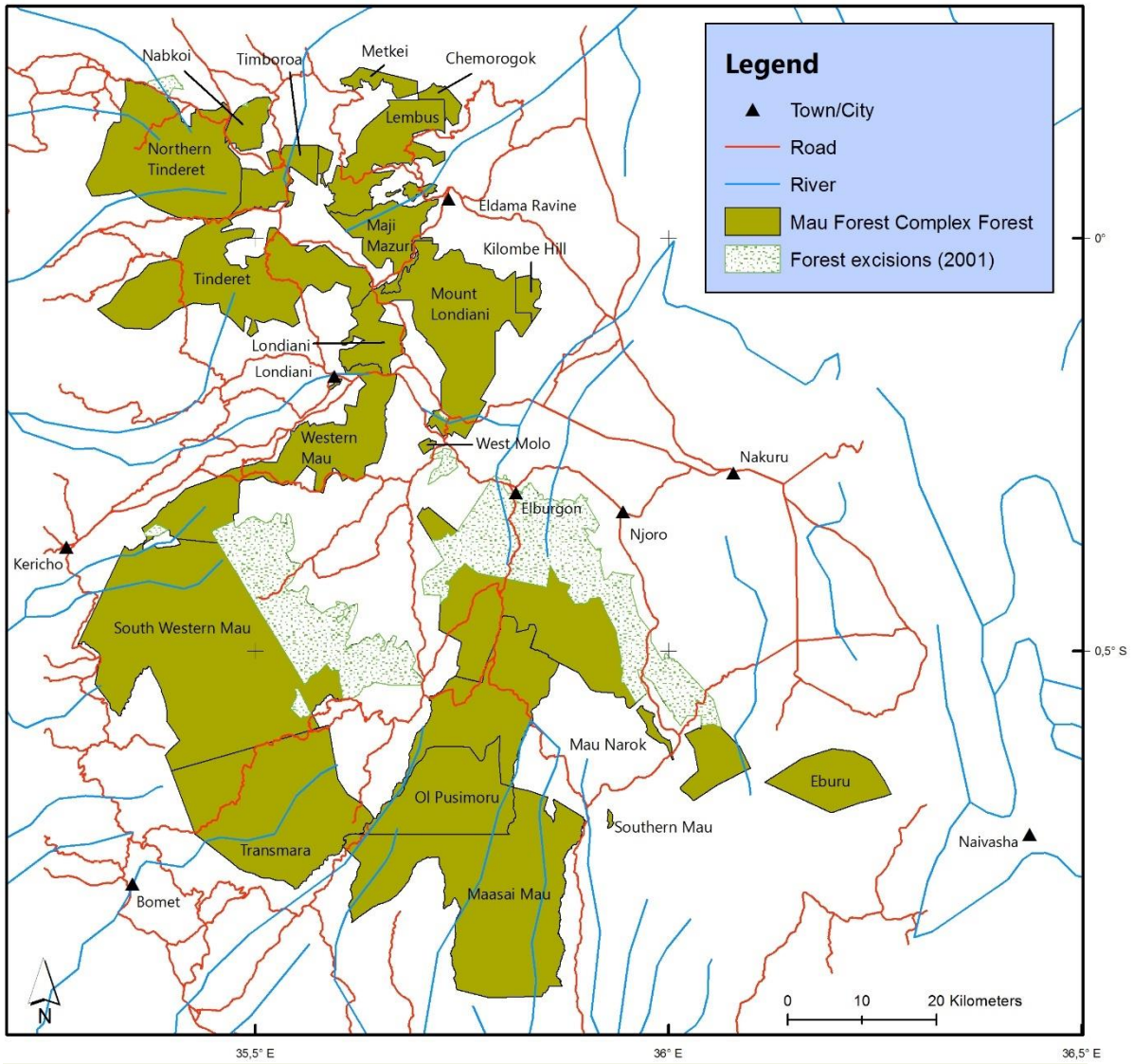


Figure 18. The major forest blocks of the Mau Forests Complex, Kenya.

CHRONOLOGY OF FOREST LOSS IN THE SOUTH WESTERN MAU FOREST RESERVE

The W Mau FR and SW Mau FR are managed by KFS, while KWS is responsible for management of the wildlife. When gazetted in 1932, SW Mau FR covered 954 km². In 2001, the Government of Kenya excise 234 km² in the eastern SW Mau FR to establish five settlement schemes; Kiptagitch Extension B, Korau, Ndoinet, Saino, and Tinet. The official justification for the forest excision was to settle Ogiek (= Okiek) families who were residing in the forest (Sang, 2001; Spruyt, 2011). This excision was challenged before the High Court. The High Court has restrained Government from moving forward with the excision process.

Figure 19. Typical view of the 2001 excised area of the South Western Mau Forest Reserve, Kenya. The area is a mix of cropland, pasture, and small plantations of exotic trees.

The excised area comprised the entire part of the SW Mau FR located in Nakuru District. The 2001 excision boundary lies along the Kericho District - Nakuru District boundary. This is a straight line that runs perpendicular to many tributaries of Sondu River.

During the settlement process that started in 1996 and spanned over 10 years, many non-Ogiek families moved into the five settlement schemes. These new settlers had little attachment with SW Mau FR and did not respect the 2001 excision boundary. By 2006, *ca*. 200 km² of the forest to the west of the 2001 excision boundary were encroached by *ca.* 1,687 families (as determined by an aerial point sampling survey conducted by the Department of Resource Surveys and Remote Sensing).

In order to address this crisis situation in SW Mau FR, and in other forest blocks in the Mau Forests Complex, the Government of Kenya established a multi-stakeholder Task Force on the Conservation of the Mau Forests Complex in July 2008. The report of the Task Force, which was endorsed by the Cabinet on 30 July 2009 and by the Parliament on 15 September 2009, recommended that "*encroachers should be removed from the forest immediately*". In line with the recommendations of the Task Force, encroachers were removed from SW Mau FR in November 2009.

Since November 2009, KFS has conducted patrols towards maintaining the east boundary and preventing new settlements. Pressures on the forest resources have, however, remained high, as established during a surveillance flight conducted in November 2015. An estimated 1,500 livestock were grazing in the forest. In addition, charcoal making has emerged as a chief threat to the forest.

On-the-other-hand, an increased number of crop raiding incidents has been reported in Kuresoi area, attributed to elephants coming, most likely, from SW Mau FR and Transmara Forest Reserve.

Based on the success of the Aberdare Electric Fence and the Eburu Electric Fence, construction of a game-proof electric fence, or another suitable physical barrier, may provide a long-term solution to the twin challenges of unsustainable extraction of forest resources and human-wildlife conflicts affecting SW Mau FR.

Here is a summary of the chronology of the change in size of the SW Mau FR. This is the area that is not degazetted, excised, or encroached.

- 954 km² in 1932. Original gazettement as a Protected Forest.
- 907 km² in 1934-1957. Five excisions totaling 46 km².
- 907 km² in 1964. Declared a Central Forest Reserve, but already intensively logged. Now a mosaic of 'climax' and 'colonizing' forest.
- 824 km² in 1968-1991. Five excisions and two additions for a net loss of 83 km².
- 870 km² in 1988. Considered to be the least disturbed forest in the Mau Forests Complex.
- 840 km² in 1992. 319 km² (38%) now grassland or scrub due, in large part, to illegal clearance and burning. Area of closed canopy, species-rich, montane forest is only 235 km² (28%). 6 km² of montane forest converted to Nyayo Tea Zone.
- 600 km² in 2001. Excision of 234 km² (28%) for settlement of 9,216 Ogiek families and designated for degazettement.
- 410 km² in 2005. During 2001-2005, 200 km² (33%) encroached by 1,687 families.
- 600 km² in 2006. During 2009, encroachers removed from 190 km² of deforested land, much of it cropland. 8.2 km² still encroached.
- 600 km² in 2016. This is the area that has not been excised. Of this, at least 190 km² is grassland/scrub/bracken fern that is heavily used by livestock. Less than 400 km² is forest, much of which is fragmented and probably all of which is degraded. Nyayo Tea Zone accounts for >6 km² and encroachment accounts for 8.2 km². In addition, 3.7 km² have been allocated to the Kericho Rural Multipurpose Co-operative Society for tea growing, of which 2.3 km² have already been cleared of forest (SMCA, 2106).

The area of SW Mau FR in 2016 (590 km²) that is not excised or encroached is 62% of the area gazette in 1932 (953 km²). Degraded and fragmented, the quality of the forest that remains (much of it secondary forest) in 2016 is far poorer than the (mainly primary) forest that was gazetted in 1932.

LOCATION OF SOUTH WESTERN MAU, WESTERN MAU, AND TRANSMARA FOREST RESERVES

The SW Mau FR (originally 953 km² but, after excisions, now 600 km²; see above) is located in southwest Kenya (S 00.36 – S 00.65; E 35.71 – E 35.29).

The W Mau FR lies off the north end of the SW Mau FR. The W Mau FR was originally 279 km² but, after several excisions, is now 218 km². Most of the W Mau FR is now comprised of exotic tree plantation, but there are 59 km² of indigenous montane forest contiguous with the SW Mau FR (SMCA, 2016).

The Transmara FR lies off the south end of the SW Mau FR. The Transmara FR is 344 km² but has been subjected to irregular allocations of land in the northwest corner. The montane forest on these allocations has since been cleared and the land planted in tea (*e.g.*, 9.4 km² Kiptagitch Tea Estate; 1.6 km² Ole Tipi's Tea Farm; 0.4 km² Narok County Council Tea Farm) (SMCA, 2016). Some of these tea estates extend into SW Mau FR. See Figure 20 as well as the maps in SMCA (2016).

ADMINISTRATIVE SITUATION

The W Mau FR and the SW Mau FR are located in three counties: Nakuru, Kericho, Bomet. Most of the unexcised part of SW Mau FR lies in Bomet County.

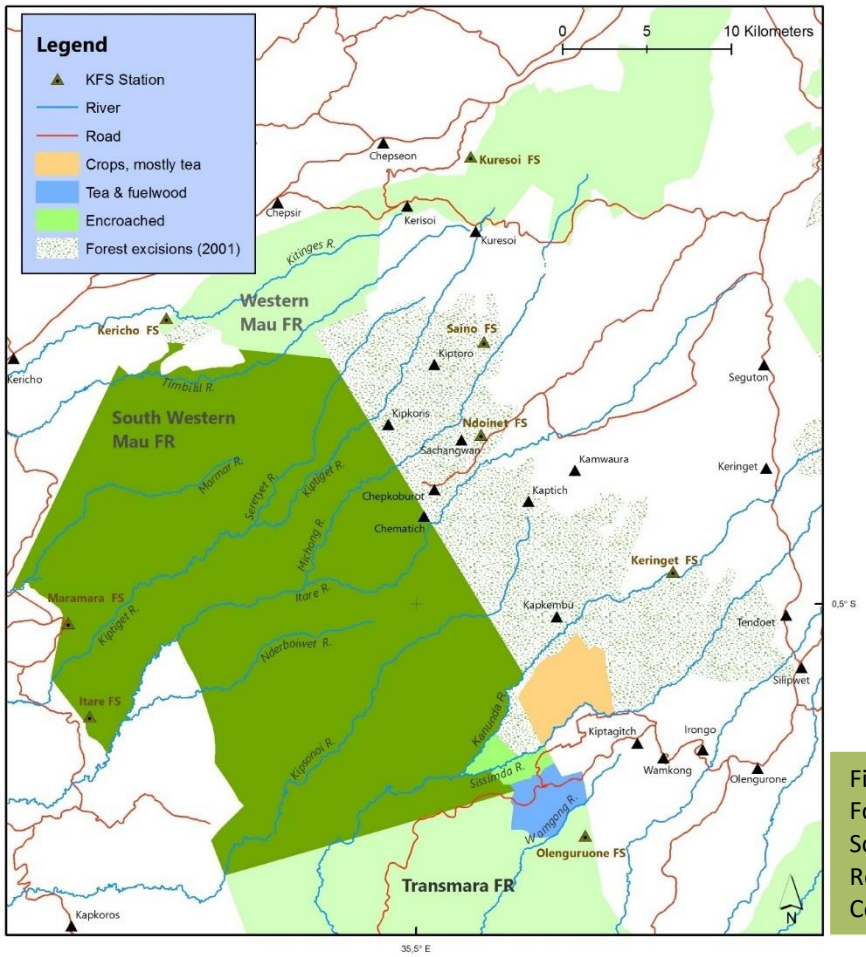


Figure 20. Western Mau Forest Reserve and the South Western Mau Forest Reserve of the Mau Forests Complex, Kenya.

ELEVATION AND TOPOGRAPHY

Hydrology and Drainage

The W Mau FR and SW Mau FR comprise part of the main catchment (*i.e.*, Mau Forests Complex) of southwest Kenya, representing one of Kenya's largest areas of heavy reliable rainfall. The slopes are drained by simple, parallel streams, flowing mainly to the southwest (Figure 2). These streams feed a large area of Kenya, including Lake Victoria, Lake Nakuru, and Lake Turkana. Water is probably the most important single product provided by the W Mau FR and SW Mau FR, as it provide drinking water for millions of people, livestock, and wildlife, supports major hydro-electric power plants and irrigation schemes. If the forest cover of these two Forest Reserves were destroyed, the sediment load in the rivers would increase dramatically, causing numerous problems downstream. In addition, many of the perennial streams would become seasonal, the effects of which would be disastrous (Nabutola, 2010).

Soils

The soils of the W Mau FR and SW Mau FR are generally of high fertility and well drained, with high levels of organic matter in the upper layers.

AGRICULTURE

The forest-adjacent areas of the W Mau FR and SW Mau FR generally have a high agricultural potential, with relatively fertile soils and reliable rainfall. As such, they are well suited to mixed farming of crops and livestock. Maize, beans, wheat, Irish potato, cabbage, and tea are major crops. Dairying and beef cattle, sheep and goat production are important sources of cash.

For information on the Nyayo Tea Zone, see pages 30 - 33.

Figure 21. Agriculture just east of the Western Mau Forest Reserve's 2001 excision boundary at Kibaraa, Kenya. Note the near absence of large trees in the former encroached area to the west (left) of the excision boundary.

HUMAN-WILDLIFE CONFLICT

During the 19th century there was a rapid escalation of the conflict between people and wildlife. This conflict is worldwide, but is most obvious and serious in developing countries with a rapidly expanding human population. With a human population that doubles every 20-25 years, Kenya is one of those countries. As human populations grow, the natural resources available to each person become increasingly less and wildlife populations become compressed. Conflicts (not only between people and wildlife but also among people) become ever more frequent, severe, and complex as people scramble to secure ever more scarce and valuable natural resources.

Montane forest lands, with their relatively rich soils and good rainfall, have high agricultural potential. As such, this forest type has been more extensively destroyed than any other in Africa. This is extremely worrisome, both from the perspectives of biodiversity conservation and long-term human welfare and survival.

With extensive loss of habitat, populations of some species of wildlife (*e.g.*, elephant, buffalo, and bongo) are compressed into increasingly small areas and poorer habitats. At the same time, human population densities continue to increase on the boundaries of protected areas and, as resources become more scarce, people become less tolerant both of the negative impacts of wildlife and of those laws that have been established to protect natural resources.

Local people claim that elephants cause the most damage to crops and property around the W Mau FR and SW Mau FR. Here, hyaena and porcupine are said to also cause serious damage. Among the main crops consumed and damaged by wildlife around these two Forest Reserves are maize, beans, Irish potatoes, wheat, and cabbage. Hyaena and leopard kill cattle, sheep, and goats.

Figure 22. The spotted hyaena *Crocuta crocuta* is one of the species most involved in human-wildlife conflict in the Western Mau Forest Reserve and South Western Mau Forest Reserve, Kenya. This species is the primary predator of livestock in the region.

While wild animals encroach upon and do damage to agricultural lands, livestock, and exotic tree plantations, people illegally destroy wildlife directly through poaching, and indirectly by degrading or destroying the habitat on which wildlife depends. Around the W Mau FR and SW Mau FR, the pressure to illegally remove forest products, and to illegally destroy forest to establish farms, is very high.

At this time, the pressures of certain species of large mammal on crops around the W Mau FR and SW Mau FR, and of people on the natural forests, are so intense that the authorities charged with managing and protecting these forests, and the crops, livestock, and people around them, can no longer effectively do so. Establishing a barrier to the movement of wildlife out of the W Mau FR and SW Mau FR, and to the movement of people into these Forest Reserves, is widely believed to be a necessary step towards significantly reducing the level of conflict between people and wildlife, and towards helping to ensure that over-exploitation of natural resources is stopped.

CONSERVATION INSTRUMENTS

This section presents a summary of 14 conservation instruments (*e.g.*, policies, conventions, agreements, plans, protocols), all of which relate in some way to the conservation of the SW Mau FR and provide guidance and support for its long-term management and sustainable use. Additional conservation instruments are presented within some of the instruments mentioned here. Also see, on pages 54 - 55, recommendations for the conservation of the Mau Forests Complex that were put forth by the Task Force on the Conservation of the Mau Forests Complex. Additional conservation instruments are mentioned in Nabutola (2010).

THE CONVENTION ON BIOLOGICAL DIVERSITY

The Government of Kenya is a signatory to the Convention on Biological Diversity. This convention identifies the responsibility of nations to conserve their biological diversity and to use their biological resources in a sustainable manner. The Convention further notes that it is important to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source, and that in *situ* conservation of ecosystems and natural habitats is a fundamental requirement for the conservation of biological diversity.

The Articles of the Convention on Biological Diversity specifically call upon nations to conserve biological diversity through the following activities:

- Develop national strategies for the conservation and sustainable use of biological diversity.
- Identify and monitor components of biological diversity important for conservation and sustainable use, and identify activities likely to have significant adverse impacts on the conservation and sustainable use of biological diversity.
- Establish a system of protected areas, and promote environmentally sound and sustainable development in areas adjacent to protected areas.
- Develop and maintain legislation to protect threatened species.
- Require environmental impact assessments of proposed projects likely to have significant adverse effects on biological diversity, and allow public participation in such procedures.

FOREST PRINCIPLES

The Government of Kenya is a signatory to the Forest Principles. The Forest Principles represent the first global consensus on conservation, management and sustainable development of forests. Though not legally binding, signatories commit themselves to up-holding the principles at the highest political level (see IUCN, 1996).

KENYA'S NATIONAL ENVIRONMENT ACTION PLAN (NEAP)

The objective of Kenya's National Environment Action Plan (NEAP) is to integrate environmental considerations into economic planning and programmes for sustainable development (MENR, 1994b).

Specific recommendations in NEAP relating to the conservation of natural forests include:

- Conserve plants and animals through integrated forest management systems, and provide forest produce for subsistence and commercial needs on a sustainable basis.
- Identify and manage forest areas important for water-shed protection.
- Stop further degazettement and excision of forest land.
- Inventory Kenya's indigenous forests and develop management plans for these areas that include conservation measures.
- Involve local people (forest dwellers) in forest management.
- Take into account the global agreements to which Kenya is a party, especially those relating to forests, biodiversity or climatic influences, in forestry planning and management.

KENYA WILDLIFE SERVICE POLICY

The KWS (1990) policy for wildlife conservation has the following stated principles:

- To conserve the natural environments of Kenya and their fauna and flora for present and future generations.
- To use the country's wildlife resources sustainably for national economic development and for the benefit of people living in wildlife areas.
- To protect people and property from injury or damage from wildlife.

Within national parks there is a policy of non-consumptive use. In addition, there is a policy of benefit-sharing with adjacent local communities so that they do not need to get resources directly from the national park.

KENYA WILDLIFE SERVICE/KENYA FOREST SERVICE MEMORANDUM OF UNDERSTANDING

In 1991, KWS and KFS signed a memorandum of understanding for the joint management of selected forest. Both parties agreed to pursue their common goals for natural forest conservation through the preparation and implementation of joint forest management plans which do not require Forest Reserves to change their legal status.

LIVESTOCK GRAZING IN FOREST RESERVES

Livestock graze in large numbers in Kenya's natural forests, causing much damage to the natural vegetation. Regeneration of trees is particularly affecting through browsing and trampling. In 1990, a ban was placed on all grazing within Forest Reserves. This ban, however, appears to have had little if any effect on reducing grazing (FAO, 1994; this study).

LOGGING OF INDIGENOUS TREES

Kenya's natural forest, perhaps particularly the W Mau FR and SW Mau FR, have been unsustainably logged. In 1986, a Presidential Decree banned the felling of indigenous trees. Nonetheless, the cutting of indigenous trees continues at an unsustainable rate in the W Mau FR and SW Mau FR.

SHAMBA SYSTEM IN PLANTATIONS

Initially, the 'Shamba System' [= 'Taungya System' = 'Non-resident Cultivation' (NRC); now referred to as the 'Plantation Establishment for Livelihood Improvement Scheme' (PELIS)], involved the employment of 'Resident Labour', housed in settlements in the Forest Reserve, whose employment and residence were contingent on their cultivating land on which tree plantations could be established (Witcomb & Dorward, 2009; Gichuru, 2015). Once the seedlings were planted these farmers were required to care for them. Although the farmers were not paid for tending the trees, the other crops grown on these plots belonged to them and they received payment for other work done for KFS. They were also allowed to keep livestock in the Forest Reserves. Typically, these farmers were temporarily allocated 0.4 ha plots for 3-4 years in order to reestablish crops of exotic trees (mostly *Cupressus lusitanica, Pinus spp.,* and *Grevillea robusta)*. Allocation and use of these plots was contingent upon the good care and survival of the tree seedlings. The success of the Shamba System is obviously dependent on the strict enforcement of the rules.

The Shamba System in Kenya began to break-down after Independence when 'Resident Labourers' became civil servants and were allowed to retire in the Forest Reserves (FAO, 1994). Large areas of cropland were established in Kenya's Forest Reserves and trees were not being planted. This has resulted in considerable environmental degradation to Kenya's Forest Reserves as a result of illegal cultivation, over-grazing and over-browsing by livestock, and agricultural encroachment (FAO, 1994; IUCN, 1996). Due to these problems, a Presidential Directive in 1985 banned the use of the Shamba

System in the course of plantation establishment. As such, the Shamba System was phased out between 1985 and 1989 (MENR, 1994a). Since that time, however, the Shamba System has been reinstated as a tool used by KFS for planting trees, although only 'Non-Resident Cultivators' are allowed to practice the Shamba System. Each Non-Resident Cultivator is licensed to cultivate an area for 3 years. Importantly, the Non-Resident Cultivator cannot live in the Forest Reserve and has no guarantee either of employment or of obtaining another plot (Gichuru, 2015).

PROTOCOL FOR SUSTAINABLE DEVELOPMENT OF LAKE VICTORIA BASIN

The following excepts from the Protocol for Sustainable Development of Lake Victoria Basin (PSDLVB, 2003) relate to the need to take actions to conservation of the SW Mau FR and its watershed:

Page 2: *WHEREAS the Partner States recognize in the Treaty that development activities may have negative impacts on the environment leading to degradation of the environment and depletion of natural resources and that a clean and healthy environment is prerequisite for sustainable development;*

RECOGNISING that water is a finite and vulnerable resource essential to sustain life, development and the environment and must be managed in an integrated and holistic manner, linking social and economic development with protection and conservation of natural ecosystems;

RECOGNISING that water is an economic good having social and economic value, whose utilization should give priority to most economic use taking cognizance of basic human needs and the safeguarding of ecosystems;

Page 5: *The Partner States have agreed to cooperate in the areas as they relate to the conservation and sustainable utilization of the resources of the Basin including the following:*

- *Promotion of sustainable development and management of forestry resources;*
- *Environmental protection and management of the Basin;*
- *Promotion of wildlife conservation and sustainable tourism development.*

Page 9: *PROTECTION AND CONSERVATION OF THE BASIN AND ITS ECOSYSTEMS*

The Partner States shall take all appropriate measures, individually or jointly and where appropriate with participation of all stakeholders to protect, conserve and where necessary rehabilitate the Basin and its ecosystems in particular by;

- *Protecting and improving water quantity and quality within the Basin;*
- *Identifying the components of and developing strategies for protecting and conserving biological diversity within the Basin;*

- *Conserving migratory species of wild animals;*
- *Conserving endangered species of wild fauna and flora;*
- *Restoring and rehabilitating degraded natural resources;*

Page 10: *SUSTAINABLE DEVELOPMENT OF NATURAL RESOURCES*

The Partner States shall manage, develop and utilize the natural resources of the Basin in a sustainable manner.

NON-LEGALLY BINDING INSTRUMENT ON ALL TYPES OF FOREST

This is an instrument for forest conservation that was adopted by the United Nations Forum on Forests in 2007 (NBIF, 2007). Here are several excerpts from this instrument that are relevant to the conservation of the SW Mau FR and to, under present circumstances, the need for conservation actions such as an electrified game-barrier:

Page 8: *Recognizing that forests and trees outside forests provide multiple economic, social and environmental benefits and emphasizing that sustainable forest management contributes significantly to sustainable development and poverty eradication.*

Page 9: *Recognizing that sustainable forest management, as a dynamic and evolving concept, aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations.*

Expressing their concern about continued deforestation and forest degradation, as well as the slow rate of afforestation and forest cover recovery and reforestation, and the resulting adverse impact on economies, the environment, including biological diversity, and the livelihoods of at least 1 billion people and their cultural heritage, and emphasizing the need for more effective implementation of sustainable forest management at all levels to address these critical challenges.

Page 11: *Objective - Reverse the loss of forest cover worldwide through sustainable forest management, including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation.*

Objective - Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest-dependent people.

Objective - Increase significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as the proportion of forest products derived from sustainably managed forests.

Page 14: *Develop and establish positive incentives, in particular for developing countries as well as countries with economies in transition, to reduce the loss of forests, to promote reforestation, afforestation and rehabilitation of degraded forests, to implement sustainable forest management and to increase the area of protected forests.*

KENYA VISION, 2030

The aim of Kenya Vision 2030 (2007) is to guide the establishment of Kenya as a "globally competitive and prosperous country with a high quality of life by 2030."

Pasted here are excerpts (with page numbers) from Kenya Vision 2030 that are most relevant to forest conservation in Kenya and, therefore, to the objectives of this report.

Page 65: *To provide adequate support to the projects and programmes expected under Vision 2030, the following policies will be accorded priority.*

Sustainable land use: The current land use practices in the country are incongruent with the ecological zones.

Page 116: *The Vision for the water and sanitation sector is "to ensure water and improved sanitation availability and access to all by 2030". Kenya is a water-scarce country with renewable fresh water per capita at 647 m3 against the United Nations recommended minimum of 1,000 m3. This compares unfavourably with the neighbouring countries of Uganda and Tanzania, which have per capita levels of 2,940 m3 and 2,696 m3 respectively. Kenyans' access to water and sanitation is relatively poor compared to countries such as Malaysia. (Figure 4.4.1) It is critical to note that Kenya's fresh water per capita has been declining and is projected to reach 235 m3 by 2025 unless effective measures to address the challenges are implemented.*

Page 118: *Catchments management: Although this is already being addressed by the Government, degradation of water sources has been caused by poor land management (mostly destruction of natural vegetation in the catchment areas through activities such as farming, encroachment and illegal logging of forests). Deforestation in the past was also caused by forest excision for farm settlement and illegal tree felling for fuel use and timber. This caused increased runoff, flash flooding, reduced infiltration, soil erosion, and siltation in the dams and other water reservoirs.*

Increased demand as a result of population growth and economic development: The growing population (expected to reach more than 60 million by 2030) and increasing economic activities will increase demand for water for domestic use, food security, and industrial development.

Page 124: *Sustainable management of natural resources: Kenya's main forests constitute five water towers (Mt. Kenya, Aberdares Range, Mau Escarpment, Cherangany Hills and Mt. Elgon), which cover more than 1 million hectares and form the upper catchments of all main rivers in the country. In the past two decades, Kenya's forests have experienced severe destruction as a result several factors, the main one being increased demand for agricultural land. This has, in turn, affected the hydrological cycles in*

the water towers and resulted in water shortages across the country. Current forest cover is less than 3 per cent compared to the internationally recommended 10 per cent. Degradation of Mt Elgon and Cherangany catchment areas has resulted in flooding in the regions around River Nzoia (Budalangi). Further, continued degradation of the Mau escarpment, which supports the Mara reserve, will have adverse effects on the tourism sector in the future.

Page 125: *Wild animals in their natural habitat: Wildlife accounts for 90 per cent of safari tourism and 75 per cent of total tourism earnings. The main challenges in wildlife conservation are: poaching; human-wildlife conflicts; habitat destruction; and, changes in land use patterns. The challenges are further compounded by incomplete information on wildlife census and species dynamics. These factors are aggravated by reduction in dispersal areas and blockage of migration corridors for areas bordering parks. Continued reduction in wildlife and critical habitats can undermine sustained growth in the tourism sector and reduce competitiveness with other countries.*

Page 127: *The vision for environment*
The vision for the environmental sector is "a people living in a clean, secure and sustainable environment". The vision is inspired by the principle of sustainable development and by the need for equity in access to the benefits of a clean environment. To realise this vision, the focus will be on four strategic thrusts:

The country will intensify conservation of strategic natural resources (forests, water towers, wildlife sanctuaries and marine ecosystems) in a sustainable manner without compromising economic growth. Kenya intends to have achieved 10 per cent forest cover by 2030.

Page 128: *Concrete goals based on the current status and identified benchmarks were set for 2012.*

- *Conservation: The overall goal in forest conservation is to increase current forest cover by 50 per cent. This will include significantly improving the contribution of forest services to the economy and providing a base for the growth of the forestry sector. Regarding wildlife conservation, the goal is to fully protect all wildlife ecosystems. This will sustain the anticipated high growth rate of the tourism sector.*

Page 129: *Under Conservation, the main strategies to achieve the goals on conservation include:*

- *Rehabilitation of degraded water catchments areas while promoting on-farm forestry;*

- *Secure wildlife corridors and migratory routes and reverse wildlife loss.*

Page 130: *Improve security of protected areas.*

Flagship projects

1. *Water catchment management: This project entails full rehabilitation of the five water towers of Mau Escarpment, Mt. Kenya, Aberdare Ranges, Cherangany Hills and Mt. Elgon.*

2. *Secure wildlife corridors and migratory routes*: *Most wildlife corridors and migratory routes have been interfered with by human activities. It will be necessary to reclaim them if wildlife is to continue providing the base for the tourism sector.*

THE NATIONAL WILDLIFE CONSERVATION AND MANAGEMENT POLICY, 2012

Page 6: The National Wildlife Conservation and Management Policy, 2012 (NWCMP, 2012), "*makes provision for an overarching framework for the prudent and sustainable conservation, protection and management of wildlife and wildlife resources in Kenya, with incidental provision on access and the fair and equitable distribution of benefits accruing there-from, and its alignment with other sector-specific laws and the environment policy."*

Page 8: *The goal of the Policy is to create an enabling environment for the conservation in perpetuity, Kenya's rich diversity of species, habitats and ecosystems for the well being of its people and the global community in accordance with the Constitution.*

Here are three of the challenges mentioned in this policy document (page 7):

Biological diversity: One of the major challenges facing Kenya is the loss of biological diversity. Land use changes favouring agriculture and rural and urban development have led to the reduction and modification of wild areas, resulting in the extinction of or threat of extinction to wildlife species and natural areas which serve as its habitat.

Land use: Land is one of the most important resources in Kenya as it is the base upon which activities like agriculture, wildlife conservation, urban development, human settlement and infrastructure are carried out. This has been exacerbated by lack of a national land use policy and planning. Consequently, there have been remarkable land use changes over the years. These land use changes particularly agriculture and rural and urban developments have led to fragmentation and disruption of traditional wildlife movements and migrations.

Destruction of wildlife habitats: Wildlife habitats provide an important resource base for rural people's livelihoods. However, rapidly increasing populations, poverty, demand for fuel wood and other complex socio-economic factors have put enormous pressure on the scarce productive lands forcing large segments of the rural poor to resort to poor land use practices. Poor cultivation methods, deforestation, charcoal burning and overgrazing, are some of the main factors causing severe wildlife habitat degradation.

KENYA FOREST POLICY, 2014

Here are some excerpts from the Kenya Forest Policy, 2014 (2014) that are relevant to the conservation of the SW Mau FR and construction of an electric game-proof barrier.

Page 5: *The overall goal of this Policy is sustainable development, management, utilization and conservation of forest resources and equitable sharing of accrued benefits for the present and future generations of the people of Kenya.*

- Two of the objectives of the Kenya Forest Policy, 2014 are: *Increase and maintain tree and forest cover of at least ten percent of the land area of Kenya.*

- *Promote public, private and community participation and partnership in forest sector development.*

- *Enhance management of forest resources for conservation of soil, water biodiversity and environmental stability.*

Page 6: The following are among the guiding principles of this policy:

- *An integrated ecosystem approach to conserving and managing forest resources will be adopted and enhanced to ensure that all forest ecosystems are managed in an integrated manner for the benefit of the people of Kenya.*

- *All forest resources shall be managed sustainably to yield social, economic and ecological goods and services for the current generation without compromising similar rights of future generations*

- *Special consideration shall be taken to conserve ecologically fragile areas in order to conserve biodiversity, soil and water.*

Page 7: Accordingly, Government will "*Rehabilitate, restore and protect degraded forest ecosystems, water towers, catchment areas and other ecologically fragile areas."*

ITARE PARTICIPATORY FOREST MANAGEMENT PLAN (2013-2017)

To date, there is one participatory forest management plan for SW Mau FR. This is the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012). Here is some of the more relevant information from that plan as concerns conservation of the SW Mau FR and construction of an electric game-proof barrier.

Page iv: Goal - *To fully involve the local community and other stakeholders in conservation and sustainable management of the natural and physical resources in Itare forest for the present and future generations".*

Overall objective - *To have a participatory approach to the management of its natural and physical resources to ensure local communities and stakeholders derive economic benefits in a sustainable manner".*

Page 2: *Itare Forest is 167 km². There is a 0.9 km² Nyayo Tea Zone, some of it cleared but not planted.*

Page 12: *Major illegal activities are logging, charcoal making, fire, poaching of wildlife, debarking of trees for medicines, and livestock grazing and browsing.*

Page 16: *Most farms are 1-9 acres.*

Page 17: *The main crops are: maize, tea, cabbage, beans, and potatoes.*

Page 18: *Local people find the forest most valuable for livestock grazing, fuelwood, timber, water, honey, and medicinal herbs, with grazing and fuelwood being most important. The Plan allows for the continued taking of these resources, but in a more controlled, scientific, and sustainable fashion.*

Pages 18: *Main conflict with wild animals is crop damage from elephants and monkeys.*

DATA COLLECTION METHODS

DESK STUDY AND PREPARATIONS

Prior to the start of the fieldwork, a detailed search was conducted to obtain maps, reports, and publications related to the Mau Forests Complex, W Mau FR and SW Mau FR (*e.g.,* history, conservation values, economic values, biodiversity, management plans, threats, political issues).

SURVEY TEAM

The survey team was comprised of the following:

- The Project Co-Leaders (Dr. Thomas M. Butynski & Dr. Yvonne A. de Jong) to (1) plan, develop, and implement the project; (2) direct, oversee, and mange team activities; (3) conduct forest exploitation and wildlife transects; (4) undertake camera trapping surveys; (5) produce the final report; and (6) present the findings at meetings.
- Three Research Technicians to (1) locate and organize field camps; (2) give the three questionnaires; and (3) assist with the compilation of data.
- Three pairs of KFS Forest Rangers (a different pair for each study section) to provide security, serve as guides, and assist with questionnaires.
- One Camp Keeper.

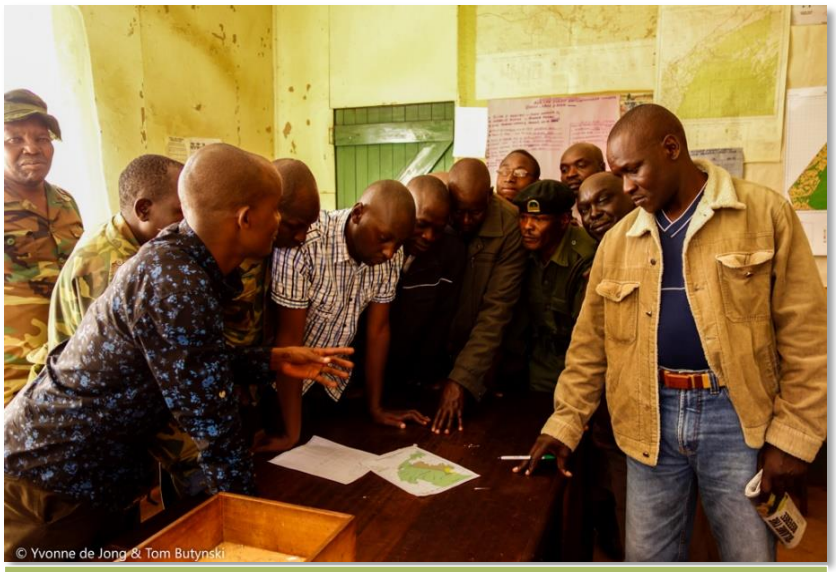


Figure 23. Organizing the Kenya Forest Service rangers at the Kenya Forest Service Station, Kericho. Six rangers provided security and served as guides and interpreters during this study.

MEETINGS

As part of this study, the Project Co-Leaders held meetings in the field with the following senior officials and leaders:

6 January -- Nakuru -- Mr. George Osuri, KWS Assistant Director, Central Rift Conservation Area; Mr. J.M. Nkanatha, Nakuru County Commissioner; Mr. David Muthoga, Nakuru County Economic

Adviser; Mr. Vincent Wohoro, Head of Regional Office, Chief State Counsel, Office of the Attorney General & Department of Justice.

6 January – Londiani – Mr. Boniface Mula, KFS Assistant Ecosystem Conservator, Kericho County; Dr. Kipkiru Langat, Senior Stakeholder Manager, ISLA-Kenya.

7 January -- Kericho – Ms. Salomi Chelelgo, KWS Warden, Kericho; Mr. Jonathan Malibe, KWS Deputy Warden, Kericho.

8 January – Kericho Forest Station – Mr. Boniface Mula, KFS Assistant Ecosystem Conservation, Kericho County; Mr. Paul Kipkorir, Official, Community Forest Association.

13 January – Kipkoris (Section 1 Barazza) – Ms. Winnie Mwaniki, Senior Program Manager, ISLA-Kenya; Mr. Thomas Kipto, Ecosystem Conservator, Kericho County; Dr. Kipkiru Langat, Senior Stakeholder Manager, ISLA-Kenya.

A large number of local officials, leaders, and elders were addressed and spoke at the three barazzas that were held on the SW Mau FR 2001 excision boundary.

On 25 February 2016, after the completion of the field work, the Project Co-Leaders attended a meeting in Nyayo Tea House in Nairobi with Mr. Wallace Gichunga and Sammy Muriithi of the Nyayo Tea Zone Development Coorporation, and Dr. Kipkiru Langat of ISLA.

During 2-3 March 2016, the Project Co-Leaders attended the 'ISLA-Kenya Master Planning Workshop' in Nairobi. About 25 people attended this workshop.

Figure 24. Brazza in Section 1 of the study area in South Western Mau Forest Reserve. Over 300 local people attened this barazza, along with representatives of Kenya Forest Department, Initiative for Sustainable Landscapes, and local officials.

THE THREE SECTIONS OF THE STUDY AREA

A description of the study area is presented on pages 54-60. The study area was divided into three sections (Figure 25):

- Section 1: Timbilil River to Michong River. Length of boundary line: *ca*. 16.2 km.
- Section 2: Michong River to Kipsonoi River. Length of boundary line: *ca*. 10.4 km.
- Section 3: Kipsonoi River to the north boundary of Transmara FR. Length of boundary line: *ca*. 14.1 km.

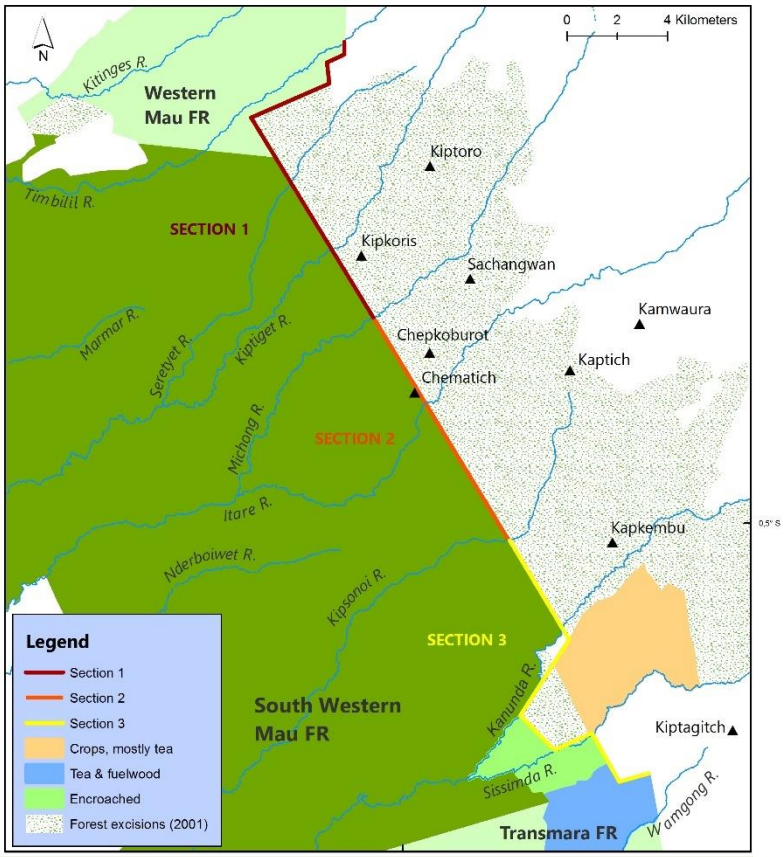


Figure 25. The three sections of the study area along the 2001 excision boundary of the Western Mau Forest Reserve and South Western Mau Forest Reserve.

FOREST EXPLOITATION AND WILDLIFE SURVEYS

Foot surveys: A total of 88.7 km of foot survey during 49.0 h were conducted over 14 days during 5-22 January 2016 west of the W. Mau FR boundary and SW Mau FR 2001 excision boundary (Figures 26; Table 2). All foot surveys were undertaken by the two Project Co-Leaders working together. The following information was collected during foot surveys: (1) habitats and terrain; (2) species of trees, birds, and medium and large mammals; (3) products people remove from the forest and level of exploitation; (4) the main access routes used by people to enter the forest; and (5) threats to the forest and wildlife.

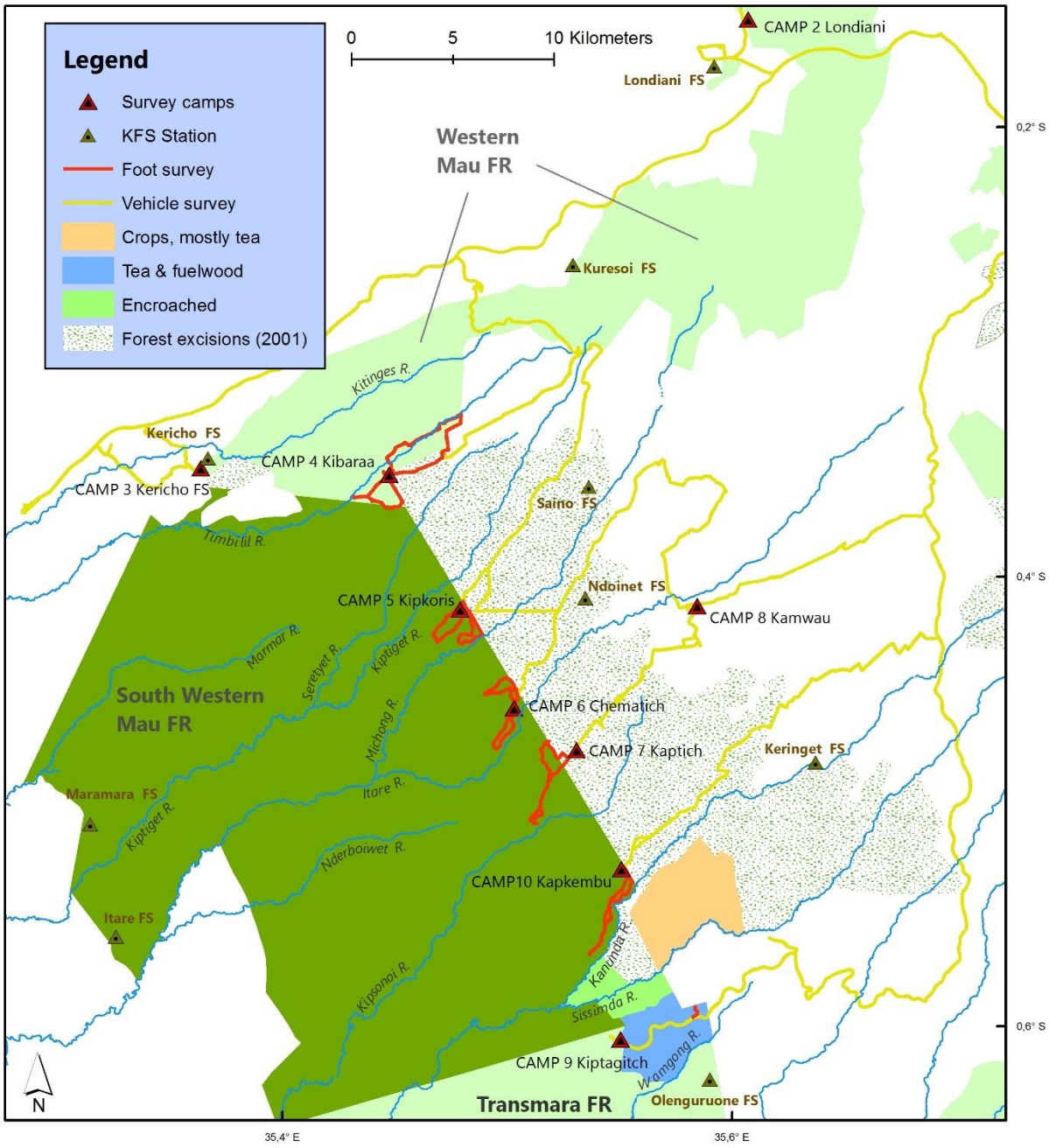


Figure 26. Survey tracks and camps in Western Mau Forest Reserve and South Western Mau Forest Reserve, Kenya.

Foot surveys were conducted in all major habitat types in the three sections (Figure 26). Zeiss Victory 10x42 and Zeiss Dialyt 7x42B binoculars were used. Foot surveys usually began soon after first light and lasted until dusk. Average walking speed was *ca.* 3 km/h. Information collected during each survey included date, weather, start time, end time, survey route with place names (Garmin GPSmap 64s), travel speed (GPS), and travel distance (GPS). When wildlife or forest disturbance was encountered, the following data were obtained: time, coordinates (GPS), altitude, species, type of disturbance, and vegetation type. Digital photographs were taken with a Sony Cybershot DSC-RX100, a Canon EOS 5d Mark III fitted with a 400 mm lens, and with an iPhone 5s.

The track of each foot survey was saved in a GPS and downloaded into an Asus SonicMaster laptop using MapSource (Garmin, version 6.16.3), MapInfo (Pitney Bowes, version 10.5), and ArcGIS (ESRI, version 10.3.1) software.

Section number	Walking time (h)	Walking distance (km)	Number of camps
1	23.2	41.2	4
2	17.8	33.8	2
3	8.0	13.7	2
Total	**49.0**	**88.7**	**8**

Table 2 Forest Reserve and South Western Mau Forest Reserve at which vegetation and disturbance were described. Summary of foot surveys conducted in each of the three sections in Western Mau Forest Reserve and South Western Mau Forest Reserve.

Landscape sample points: Sample points were taken during foot surveys. A unique number was given to each site and the vegetation and disturbance at the site were described. A 360 degrees photograph was taken at many of the sample points using the '360' application of Occipital on an iPhone 5s.

Camera traps: Nine camera traps (of various brands) were installed along survey routes and (mainly) in the vicinity of camps to document the presence and abundance of nocturnal, cryptic, and shy species of mammal (*e.g.*, cats, mongooses, genets, antelopes), as well as the larger, more terrestrial, birds (*e.g.*, Guinea fowl, francolins, crakes). The camera traps, active for a total of 486 hours, were set to take infrared-triggered photographs with a time lapse of 2 seconds. Various baits (including soya sauce, sardines, bread, dry cat food) were used to attract animals to the camera trap site.

Figure 27. One of nine infrared-triggered camera traps used during this study.

Gates: Coordinates were obtained during foot surveys of sites where the wildlife-proof barrier and community access gates should be placed in order to: (1) minimize costs of construction and maintenance; (2) best serve the conservation and management needs of the forest; and (3) best meet the needs of the community for forest products.

QUESTIONNAIRES

Because so many people live close to the W Mau FR and SW Mau FR, and because the cooperation

and support of local communities is essential to the success of a wildlife-proof barrier, it is important to understand (1) how a barrier will affect their lives, and (2) what their opinions and attitudes are concerning the barrier. Applied wisely, this information can lead to effective, long-term, (1) local support for the construction and maintenance of the barrier, and (2) to the sustainable-use and conservation of the W Mau FR and SW Mau FR.

To gather the needed information, two types of questionnaires were applied (Appendices 1 & 2):

- **Questionnaire 1, 'Head of Household'.** This questionnaire was given to 272 heads of households, all of whom live within 1 km east of the W Mau FR boundary or within 1 km east of the SW Mau FR 2001 excision boundary. This questionnaire gathered information on: (1) the demographic and economic profile of the community; (2) kind and level of human-wildlife conflict; (3) kind and level of forest products exploited; and (4) attitudes towards the proposed barrier.

Figure 28. Head of Household Questionnaire being given by the members of the survey team at Kaptich, on the South Western Mau Forest Reserve's 2001 excision boundary.

- **Questionnaire 2. 'Officials and Leaders'.** This questionnaire was given to those officials and leaders who are, in some way, responsible for the management, protection, and maintenance of the W Mau FR and/or SW Mau FR (*e.g.*, KFS, KWF, CFA, and county staff), or who are leaders in the local community. This questionnaire gathered information on: (1) kind and level of experience; (2) attitudes towards wildlife, forest management, and conservation; and (3) attitudes towards the proposed barrier.

Questionnaires were given between 5 January and 22 January 2016. They were conducted by way of oral interview, generally at the residence or work-place of the interviewee. Along with responses to the specific questions, additional information was recorded in order to better assess the situation. Anecdotal experiences, as well as specific requests, suggestions, and comments made by the respondents, were also recorded.

Responses to the questionnaires were recorded on a standard form, then entered in Microsoft Office Access and analyzed with the help of Microsoft Office Excel. Due to language difficulties, many of the interviews were conducted through an interpreter. While the interpreter was very adapt and translations were generally considered to be accurate, there is always the potential for misunderstanding and miscommunication.

Some of the people interviewed seemed to have uneasy and suspicious relations with government,

KWS, and KFS officials. Some of this may be due to inconsistency in policy. It is also likely, however, that some were involved in illegal use of the forest and forest products.

In many instances, subjects were uneasy when asked question regarding use of the Forest Reserves. As such, and it is likely that the collected data led to underestimates of the amount of forest exploitation. In some cases, it was necessary to infer from materials seen in the house, as well as from hearsay, how much use was actually occurring. It is also likely that some individuals somewhat exaggerated negative aspects of their situations in the hope of encouraging policy changes or incurring benefits.

All of these factors may have affected the recorded data, and it is important to view this study with them in mind.

BARAZZAS

Three 'barazzas' (meetings) were held with local leaders, elders. One barazza was held in each of the three sections. All three barazzas were held close to the SW Mau FR 2001 excision boundary. Local people (sometime many) also attended and participated. The objectives of these barazzas was to better understand: (1) the importance of the forest to the local community and of the community to the forest; (2) the kinds and extent of human-wildlife conflict; (3) the kinds and extent of exploitation of forest products by the community; (4) what a barrier to the forest means to the community and to the forest; (5) the current perception of the community to the barrier; (6) how the community might assist with the construction and maintenance of the barrier; and (7) how the community might become more engaged with the conservation of the forest.

Figure 29. Barazza with the community, including leaders, elders and officials at Kipkoris, 13 Jan. 2016

- Section 1 Barazza: Held on 13 January 2016 at Kipkoris (S 00.41092; E 35.48020). Attended by Ms. Winnie Mwaniki (ISLA), Dr. Kipkiru Langat (ISLA), Mr. Tom Kipto (KFS), Mr. Boniface Mulwa (KFS), Mr. Richard Tomet (Assistant Chief), and about 300 people from the community including leaders, elders, and officials.

- Section 2 Barazza: Held on 18 January 2016 at Kaptich (S 00.47710; E 35.53094). Attended by about 50 people from the community, including leaders, elders, and officials.

- Section 3 Barazza: Held on 21 January 2016 at Kapkembu Outpost (S 00.53001; E 35.55081). Attended by Dr. Kipkiru Langat (ISLA), Mr. Boniface Mulwa (KFS), and about 25 leaders, elders, and officials, including Mr. David Busendi (Chief, Timet/Kabkebu), Mr. Daniel Banl (Assistant Chief, Timet), and Mr. James Rimetoh (Pastor, Kapkembu).

Overall, the leaders, elders, officials, and local people who attended the barazzas were very positive towards the construction of a game-proof barrier and were particularly appreciative of the opportunity to be consulted and involved as concerns the barrier.

Figure 30. Barazza with the leaders, elders, and officials at the Kenya Forest Service Outpost at Kapkembu, 21 January 2016.

RESULTS SECTION 1: TIMBILIL RIVER TO MICHONG RIVER

BACKGROUND

Location: Section 1 (Figures 31 and 32) begins at the Timbilil River (S 00.32720; E 35.47933; 2,360 m asl) and runs southwards, first along the eastern boundary of the W Mau FR and then along the SW Mau FR 2001 excision boundary to the Michong River (S 00.42605; E 35.48928; 2,378 m asl).

Most of Section 1 lies within the area covered by the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012). Some of the finding found during this study mirror well those presented in the Itare Participatory Forest Management Plan, particularly those findings concerned with how local people utilize the resources of the SW Mau FR...and would like to continue to utilize the SW Mau FR.

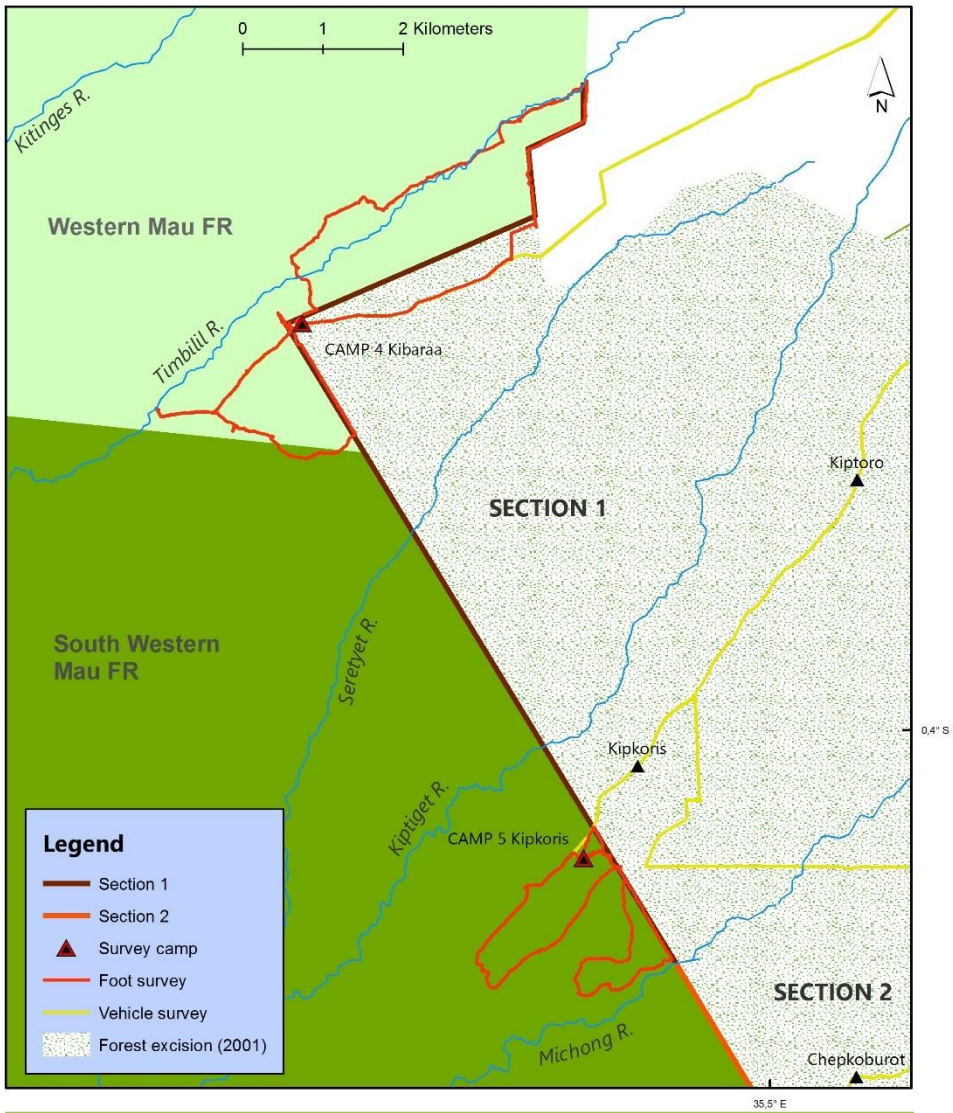


Figure 31. Section 1 of the study area in Western Mau Forest Reserve and South Western Mau Forest Reserve.

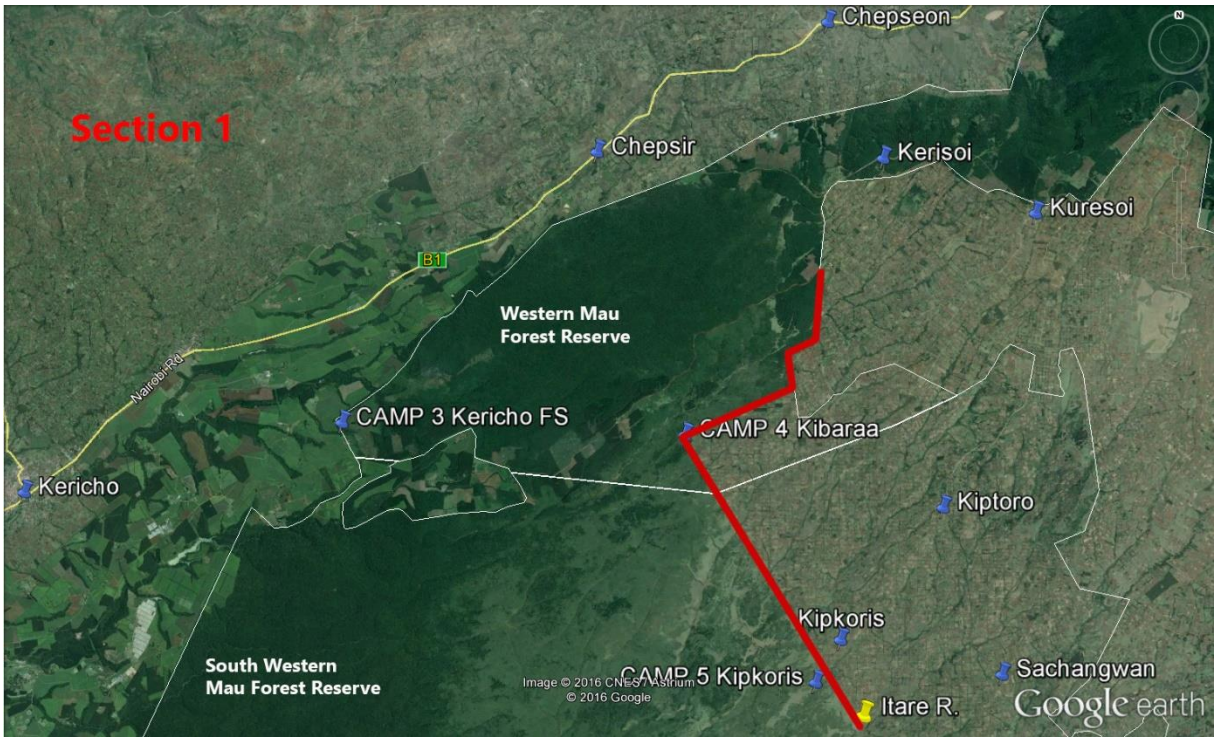


Figure 32. Location of Section 1 (red line) in Western Mau Forest Reserve and South Western Mau Forest Reserve on a Google Earth map. The red line is the east boundary of the Western Mau Forest Reserve and the South Western Mau Forest Reserve 2001 excision boundary. The area to the east is heavily settled and under intensive agriculture (greyish-brown areas). The area to the west is degraded montane forest, exotic tree plantation, and pasture. Note the extremely narrow corridor of natural forest in the area between Camp 3 and Camp 4. This is where the West Mau Forest Reserve meets the South Western Mau Forest Reserve. Note the narrow (1.8 km wide) corridor in the West Mau Forest Reserve at Kerisoi that is now devoid of natural forest. Replacing the exotic tree plantations in these areas with indigenous forest will help maintain this vital corridor. This once one of the most species-rich regions of the Mau Forests Complex. Most of the montane forest in the west part of this region was cleared for the establishment of large tea estates (solid light green areas).

Length: Section 1 has a length of *ca.* 16.2 km, of which *ca.* 7.8 km is in the W Mau FR and *ca.* 7.4 km is in the SW Mau FR (measured using ArcGIS).

Purpose: Evaluate Section 1 for placement of a game-proof wildlife barrier. This barrier is expected to (1) reduce the level of human-wildlife conflict in the area; (2) protect a large and vital watershed; (3) help secure a critical corridor between W Mau FR and SW Mau FR; (4) reduce degradation, fragmentation, and destruction of both Forest Reserves; and (5) allow for the long-term sustainable use of forest products.

This study establishes socio-economic, human-wildlife conflict, forest exploitation, and environmental baselines against which to assess change.

SOCIO-ECONOMIC ENVIRONMENT

Human population and land use:

Number of people interviewed:

- Heads of household: 109
- Officials and leaders: 12

Head of household interviewee profile:

- Mean duration on farm: 12.9 years (range <1-20)
- Mean number of people in household: 6.9 people (range 1-14)
- Mean distance of farm from 2001 excision boundary: 183 m (range 0-1000)
- Mean size of farm: 4.0 acres (range 0.2 – 15.0) (Figure 33)
- Four main crops:
  - maize (n=101)
  - potatoes (n=53)
  - wheat (n=47)
  - beans (n=46)
- Mean number of livestock per farm: 11.4 head (range 0-150) (Figure 33)
- The human population of Section 1 is high. Farm plots are mainly within the excised area (except for the northern-most 2 km). Farms are right up to the W Mau FR boundary and SW Mau FR 2001 excision boundary.

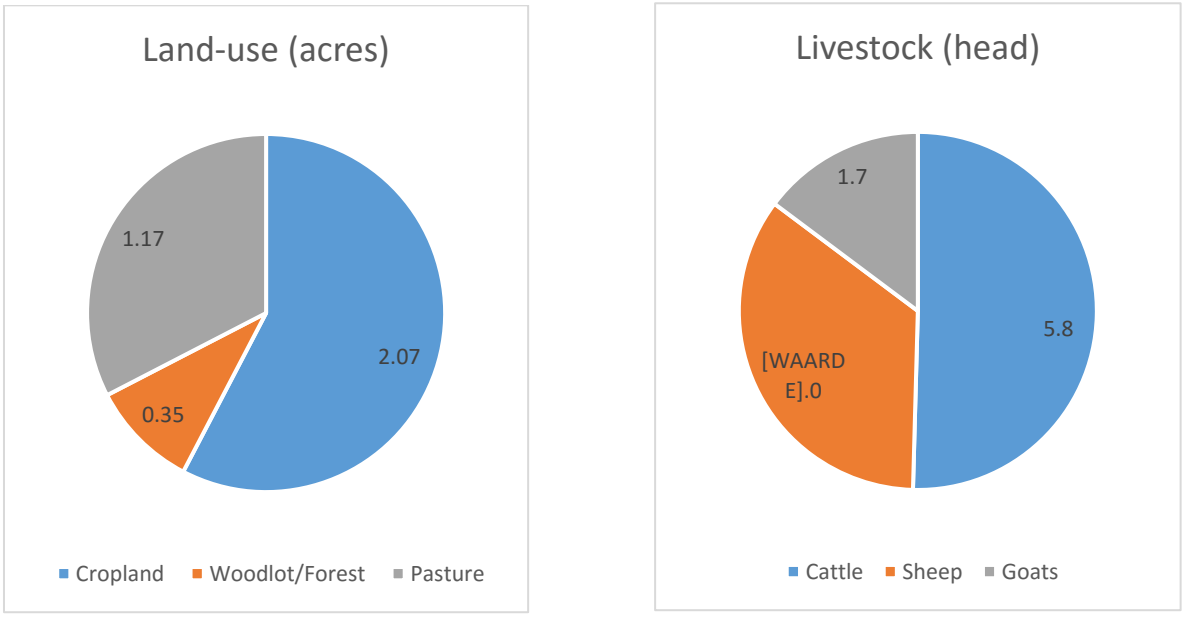


Figure 33. Main types of land-use and numbers of livestock on the average farm in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve according to the heads of households.

HUMAN-WILDLIFE CONFLICT

Damage by wildlife to crops, livestock and infrastructure (*e.g.*, fences, buildings) is a main concern of heads of households (n=109). Officials and leaders (n=12) shared this concern, but to a lesser extent (Figure 36).

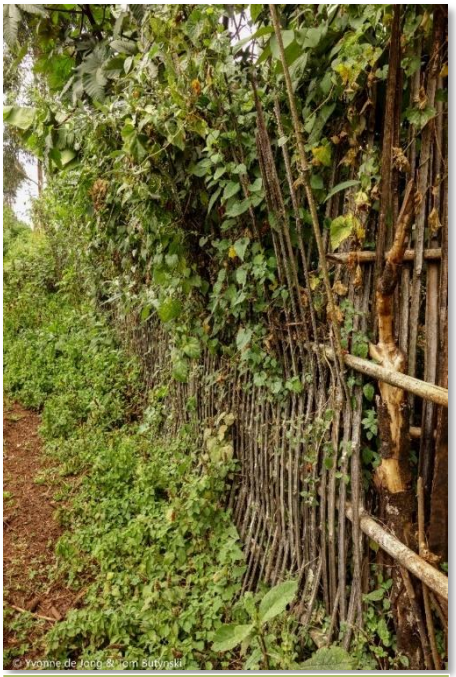


Figure 35. Bamboo fence on the Western Mau Forest Reserve 2001 excision boundary at Kibaraa. Fences such as this are placed to control both livestock and wild animals.

Crop damage:

- Head of households: 82% said 'a lot'
- Officials and leaders: 58% said 'a lot'

Livestock loss:

- Head of households: 62% said 'a lot'
- Officials and leaders: 50% said 'a lot'

Damage to infrastructure:

- Head of households: 83% said 'a lot'
- Officials and leaders: 58% said 'a lot'

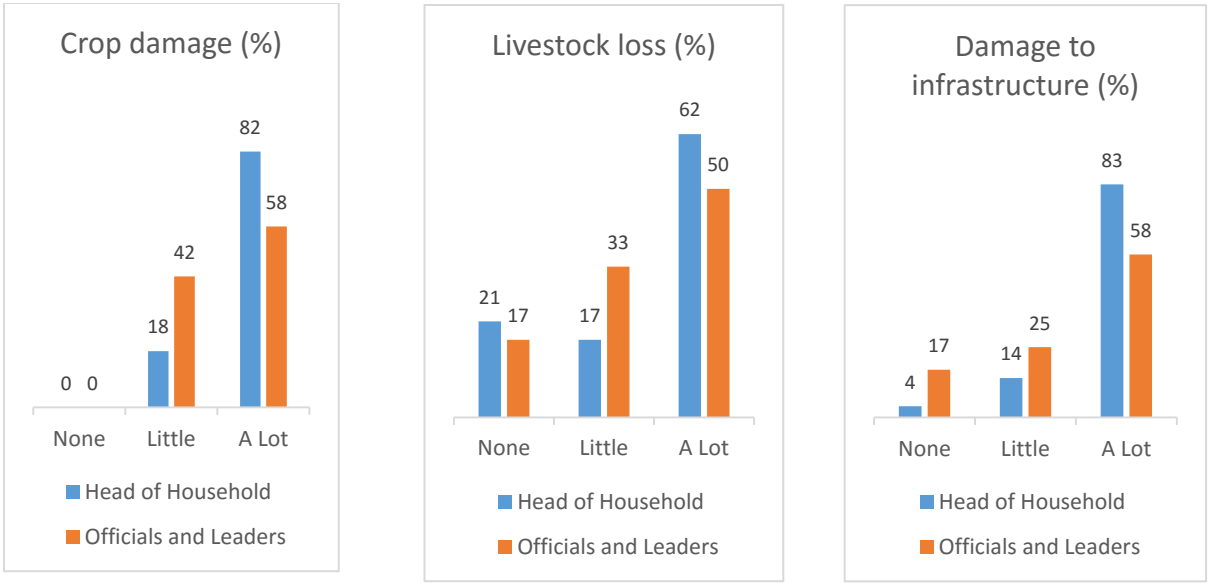


Figure 36. Crop damage, livestock loss, and damage to infrastructure by wildlife in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve according to the heads of households (n=109), and officials and leaders (n=12).

The wild animal species which cause the most damage in Section 1, according to the heads of households, are elephant, hyaena, and crested porcupine (Figure 37).

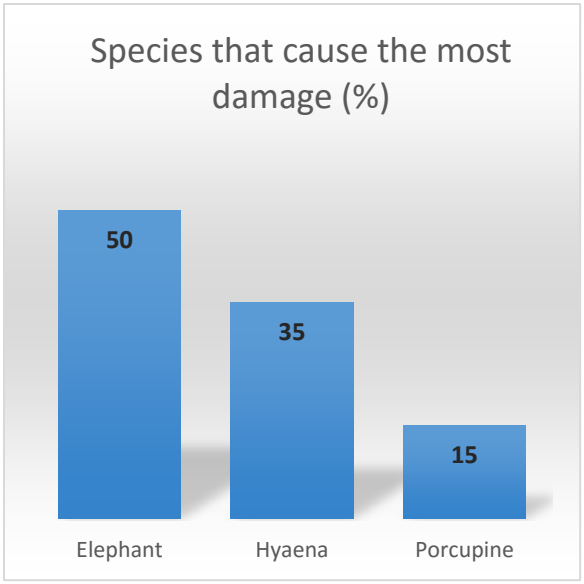
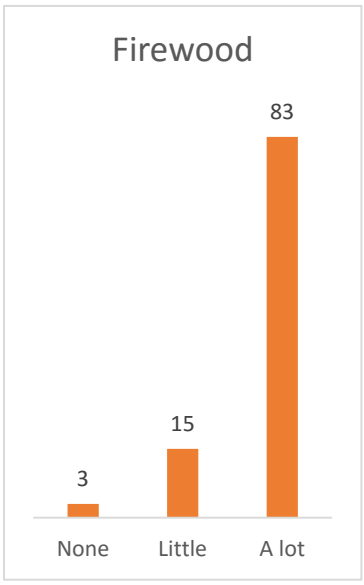


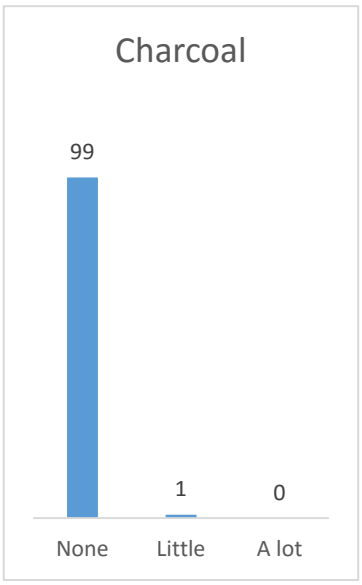
Figure 37. Species of wildlife which, according to the heads of households (n=40), cause the most damage in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve. The number at the top of each bar represents the percentage of heads of households who said that species causes the most damage.

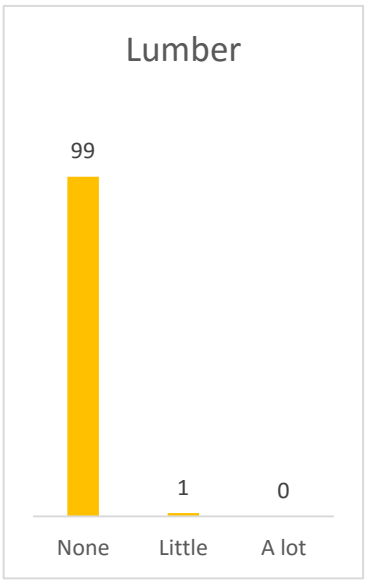
To stop wildlife from inflicting damage, interviewees (n=109) said that they use noise (89%), fire (61%), and dogs (12%). Fourteen percent of the heads of household said they report cases of human-wildlife conflict to KWS or KFS.

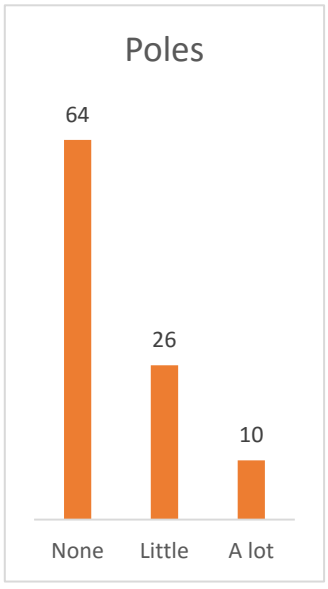
UTILIZATION OF THE FOREST RESERVES

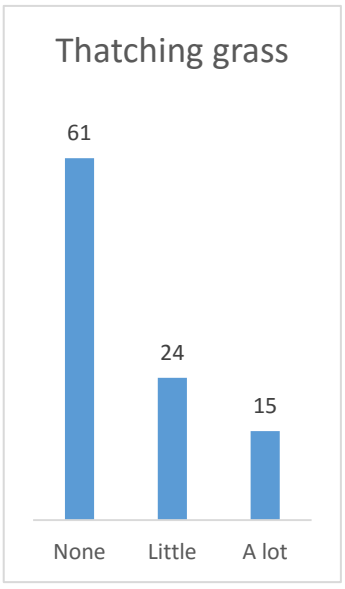
All households (n=109) in Section 1 use the W Mau FR and SW Mau FR to some extent, and almost all use these Forest Reserves 'a lot'. They use the SW Mau FR 'a lot' for firewood (83%), grazing (75%), medicines (48%), and honey (46%; Figure 38). Heads of households claim that they do not use these Forest Reserves for charcoal, lumber, or meat. Only one person said they get water from the SW Mau FR. These results suggest that there is ample charcoal, lumber, meat, and water outside the W Mau FR and SW Mau FR. See the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012) for additional information on how the local people use the forest in the Section 1 area.

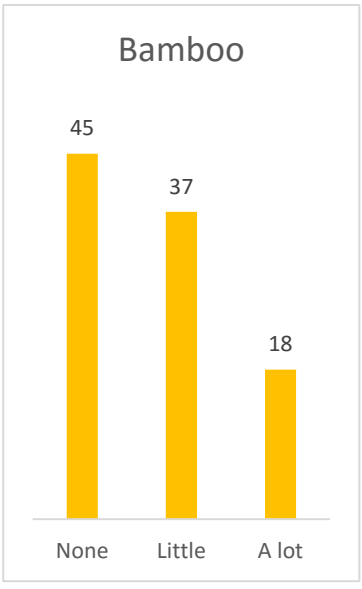


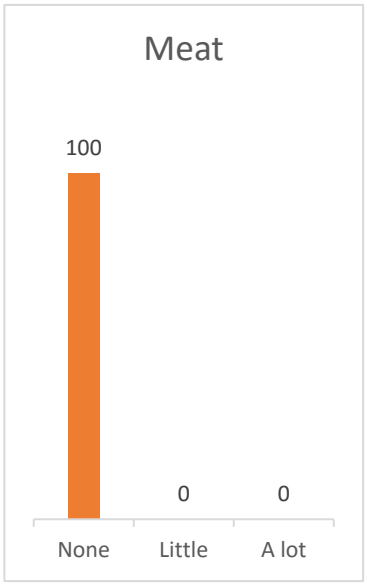


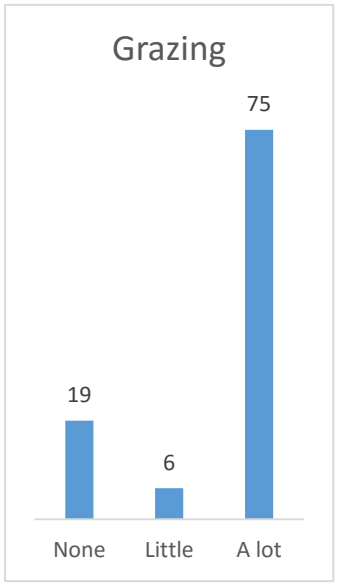


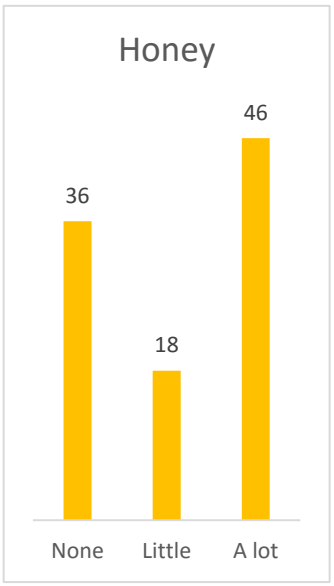


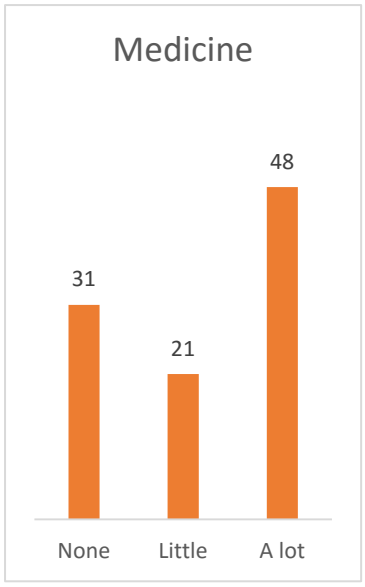












ATTITUDES TOWARDS A BARRIER

Ninety-eight percent of the heads of households (n=109) said that they would be 'happy' if an electric fence were constructed, while 2% were 'neutral' to the concept. While the respondents understood that the fence would greatly limit the level of illegal exploitation of the W Mau FR and SW Mau FR, they were positive about the potential reduction in damage by wildlife to their crops, livestock, and infrastructure. All officials and leaders (n=12) said they would be 'happy' with an electric fence.

Those leaders and residents who attended the barazza, including members of the Ogiek tribe, said they wanted an electric fence. The reasons given for local support of an electric fence included reduced damage by wildlife, reduced poaching of wild animals, and less forest destruction,

particularly as a result of charcoal-making. Interviewees also mentioned the job opportunities the construction and maintenance of a fence would bring. One interviewee noted that a fence would stop cattle rustling. Almost all interviewees (99%) believed there will be enough people within the community willing and able to help with construction and maintenance of the fence.

When heads of households (n=109) were asked, "Do you prefer a Nyayo Tea Zone or an electric fence as a barrier for the South Western Mau Forest Reserve?", 94% said "fence", 1% said "Tea Zone", and 5% said "no opinion". All officials and leaders (n=12) said they preferred an electric fence over a tea zone. Those who spoke at the barazza were also in favour of an electric fence. In general, people believe that, compared to a Nyayo Tea Zone, a fence would (1) be more effective in reducing human-wildlife conflict; (2) be more effective for forest protection; (3) give residents more access to forest products; and (4) provide more jobs. Overall, interviewees believed a fence would be a more permanent solution to their problems with wildlife and with conserving the forest. The one interviewee who preferred a Nyayo Tea Zone said that it would provide more jobs.

All interviewees of the Head of Household Questionnaire and of the Officials and Leaders Questionnaire, as well as those people who attended the barazza, said forest conservation is important. They believed that the best way to protect the W Mau FR and SW Mau FR from further degradation and destruction is through a combination of electric fencing, conservation education, community participation, people working more closely with Community Forest Associations (CFAs), additional forest rangers, increased patrols by forest rangers and community members, and planting trees.

PHYSICAL ENVIRONMENT

Altitude: The altitudinal range along the W. Mau FR boundary and SW Mau FR 2001 excision boundary is 2,360-2,460 m asl. Overall, the terrain is rather flat with gently sloping valleys where streams flow. The most rugged and steep section of the boundary is at the north end. Here, at the Timbilil River in W Mau FR, the land rises from *ca*. 2,360 m asl to 2,400 m asl over a distance of 490 m. The boundary here crosses a small stream at 2,370 m asl (S 00.32990; E 35.47927). In Section 1, 11 streams/rivers (*e.g.*, Timbilil, Seretyet, Kiptigit, Michong) flow out of the two Forest Reserves.

Rainfall: Mean annual rainfall over Section 1 is *ca.* 1,300 mm (WRI, 2007).

Soil: The soil in Section 1 is described as "*well drained, extremely deep, dark reddish–brown, friable and flightly smeary clay, with an acid humic topsoil*" (Sombroek *et al.*, 1982).

Suitability of the terrain for an electric fence: The terrain along the entire proposed Section 1 barrier line is suitable for construction of an electric fence. Given that all of the boundary was once within an encroached area, few trees would need to be removed in order to clear the 7-10 m-wide strip required by an electric fence.

Tourist attractions: This section holds the Songonyo historic site with its waterfall (not visited by the Project Co-Leaders). This might be a tourism development opportunity, perhaps particularly if combined with bird, natural history, cultural, and scenic walks.

BIOLOGICAL ENVIRONMENT

Vegetation: Section 1 lies within the 'East African Montane Forest Ecoregion' (WWF, 2004). The montane forest that was once within 3 km west of the 2001 excision boundary has been either destroyed or is extremely degraded. What remains at this time are large areas of bush, poor bamboo, recently harvested exotic tree plantation, short-grass glades, and erosion gullies. There is no primary forest here.

The more common indigenous trees found in Section 1 that were identified during this study are the colonizing, secondary forest, species *Macaranga kilimandascharica, Neoboutonia macrocalyx, Dodonaea augustifolia*, *Acacia albida,* and *Hypericum revolutum.*

Other indigenous tree species identified during this study are *Hagenia abyssinica, Olea capensis, Nuxia congesta, Podocarpus latifolius, Psychotria mahonii, Tabernaemontana stapfiana, Cassipourea malosana, Euphorbia c.f. bussei, Ficus thonningii, Albizia gummifera, Faurea saligna, Syzygium guineense,* and *Drypetes gerrardii*.

Exotic trees species present are *Pinus sp., Eucalyptus sp.,* and *Cupressus lusitanica.*

Other plants identified during this study are *Arundinaria alpina, Vernonia auriculifern, Pteridium aquilinum, Senicio* sp., *Helichrysum* spp., *Acanthus eminens, Solanum* spp., *Rubus sp., Leonotis mollissima, Impatiens* spp., *Brillantaisia nitens,* and *Piper capense.*

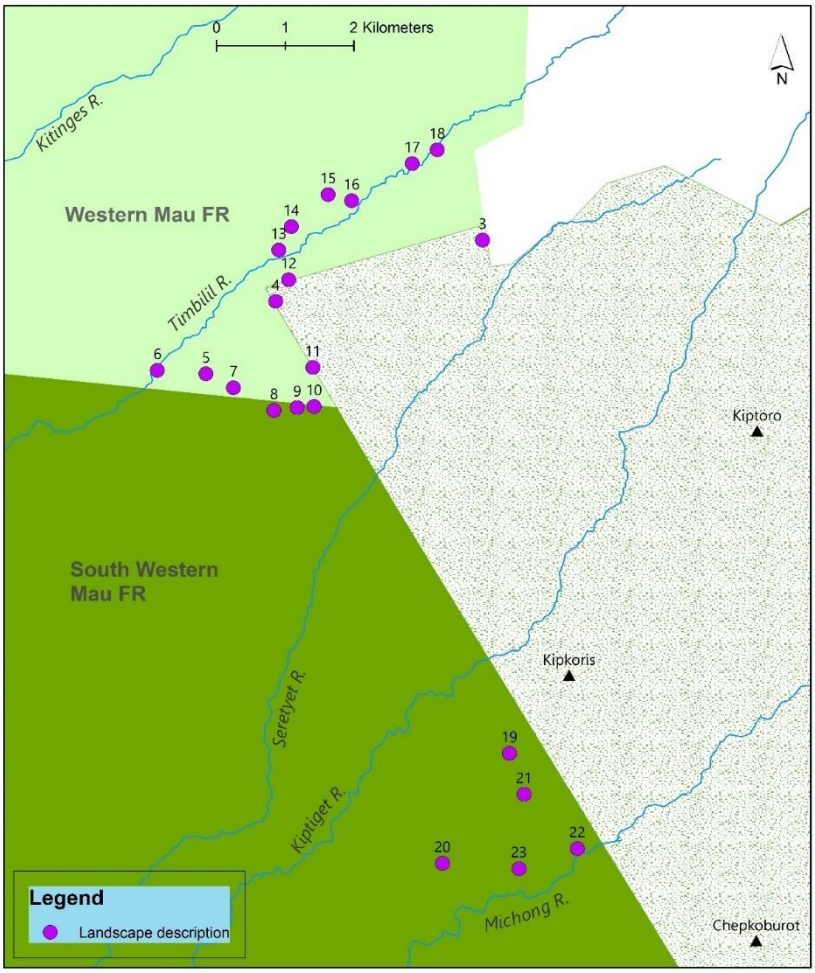


Figure 39. Locations of sample points in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve at which vegetation and habitat disturbance were described (Table 3).

Number	Date (2016)	Time (h)	Latitude	Longitude	Altitude (m)	Vegetation	Disturbance
1	9 January	09:57	S00.28069	E35.48375	2404	Pine plantation with many gaps. Western Mau FR.	Shamba System planting but widely-scattered trees 0.5-1.0 m high. Crops: sorgum, onions, peas. Logged long ago but only now being planted with exotic trees. Some areas not planted, but grazed by livestock. Old logs laying around.
2	9 January	10:05	S00.28547	E35.48453	2442	Natural forest on edge of poor cypress plantation.	Degraded. Shambas. Cutting of indigenous trees within plantation.
3	9 January	11:22	S00.28745	E35.51770	2544	Plantation with bushland and bamboo along the road. Open areas with pasture. *Hagenia*, olive, *Hypericum*, bracken.	Pasture. Sheep and cattle grazing. About 1 car/5 min, motorbike 1/min. Power-line along road.
4	9 January	12:32	S00.34689	E35.47378	2474	At corner of past encroachment.	Fenced shambas with settlements, tea plantations, potatoes. Forest degraded or destroyed.
5	9 January	12:57	S00.35492	E35.44665	2425	Edge of natural forest. Braken fern.	Fenced shambas and pasture with livestock.
6	10 January	09:22	S00.36443	E35.43751	2363	Bushland with a few medium tall trees. Some bamboo.	Heavily degraded. Livestock paths common. Eroded footpath.
7	10 January	09:59	S00.36399	E35.43113	2293	Grassland, stream, bushland bordering natural forest and plantation. Braken fern, podo, *Hypericum*, *Helichrysum*, bamboo.	A main dirt road to Kericho. Degraded natural forest, heavily-used pasture, eroded human and livestock paths. Bridge.
8	10 January	11:13	S00.36628	E35.44110	2321	Bushland and stream with patches of grassland, much bamboo braken and *Hypericum*.	Wooden bridge, eroded footpaths, livestock tracks, livestock. Heavily grazed and degraded.
9	10 January	12:14	S00.36928	E35.44640	2407	Bushland. Much braken and some bamboo.	Burned in 2015. Bushland with recently cut tree. Eroded livestock trails and human footpaths. Former area of shambas.
10	10 January	12:32	S00.36890	E35.44946	2437	Forest Reserve edge, braken fern. Much braken and some small bamboo.	Fenced shambas, livestock, eroded livestock and human trails. Beehives
11	10 January	12:43	S00.36875	E35.45166	2439	Forest Reserve edge with braken fern, bush, and some bamboo.	Fenced shambas, eroded livestock and human trails. People removing trees and firewood. Some beehives. Heavily grazed. Probably fewer trees here now than at time of eviction.
12	10 January	13:12	S00.36361	E35.45152	2369	Degraded riverine forest	Heavily used and eroded tracks into riverine forest. Chopping of wood heard. Fresh tree stumps. Heavily-used pasture. Some trees planted.
13	11 January	09:05	S00.35208	E35.44835	2363	Dense old shamba shrubland. No trees. Small grass glades, bamboo, venonia, *Dodonaea*, small *Macaranga*, scattered	Heavily degraded. Eroded livestock and human paths.

						cypress.	
14	11 January	09:37	S00.34819	E35.44705	2314	Near pine and eucalyptus plantation with many gaps. Much *Neoboutonia.* Some *Hypericum, Acacia abida,* bracken, *Macaranaga, Rubus*.	Logged a few years ago. Old logs still scattered on ground. Goats and cows present.
15	11 January	10:05	S00.34512	E35.44870	2331	Cypress plantation near natural forest. Logged 3 years ago. Much *Neoboutonia* on edge.	Old logs still scattered on ground. Heavily used by livestock. *Ca.* 50 goats and 12 cows seen.
16	11 January	10:50	S00.34091	E35.45352	2346	Logged pine on edge of eucalyptus plantation and natural forest. Logged ca. 3 years ago. Not replanted.	Used for pasture and wood. Complete loss of natural forest.
17	11 January	11:19	S00.34171	E35.45662	2321	Riverine vegetation with grass glades and seconday forest on edge of eucalyptus plantation.	Degraded natural forest. Heavy livestock grazing. Rubbish.
18	11 January	12:31	S00.33683	E35.46454	2339	Grass glade bordering riverine bushland and tall natural forest.	Heavy livestock grazing. Natural forest degraded. Eroded livestock and human trails.
19	11 January	12:50	S00.33504	E35.46783	2341	Tall natural forest with grass glades, bushland, bamboo, *Hypericum, Macaranga, Nuxia, Dodonaea, Faurea.*	Heavily used forest and pasture. Degraded.
20	12 January	15:09	S00.41430	E35.47730	2453	Grassland	Pasture, all trees removed. Much used by livestock. Degraded.
21	12 January	16:08	S00.42874	E35.46853	2398	Bushland, pasture, and bamboo near river. Some *Hypericum,* podo, *Macaranga*, vernonia, *Helichrysum, Dodonaea, Faurea.*	Degraded. Heavily used by people and livestock. Some erosion. Charcoal making.
22	12 January	17:06	S00.41967	E35.47923	2455	Grassland with shrub, braken, veronia, *Dodonaea, Faurea*, small bamboo, and a few large cypress and eucalyptus.	Heavily used pasture. Eroded livestock trails. *Ca.* 50 sheep seen. Some beehives.
23	13 January	09:32	S00.42682	E35.48620	2381	Natural forest with bushland, small areas of grass	Beehives. Heavily used pasture. Goats present. Erosion of livestock trails. Recent logging.

Table 3 Details of sample points in Section 1 of the Western Mau Forest Reserve and South Western Mau Forest Reserve at which vegetation and disturbance were described (Figure 39).

Figure 40. 360 degrees photograph of sample point 7 (Table 3, Figure 39).

Figure 41. 360 degrees photograph of sample point 8 (Table 3, Figure 39).

Figure 42. 360 degrees photograph of sample point 10 (Table 3, Figure 39).

Figure 43. 360 degrees photograph of sample point 11 (Table 3, Figure 39).

Figure 44. 360 degrees photograph of sample point 12 (Table 3, Figure 39).

Figure 45. 360 degrees photograph of sample point 14 (Table 3, Figure 39).

Figure 46. 360 degrees photograph of sample point 15 (Table 3, Figure 39).

Figure 47. 360 degrees photograph of sample point 16 (Table 3, Figure 39).

Figure 48. 360 degrees photograph of sample point 17 (Table 3, Figure 39).

Figure 49. 360 degrees photograph of sample point 20 (Table 3, Figure 39).

Figure 50. 360 degrees photograph of sample point 22 (Table 3, Figure 39).

Figure 51. 360 degrees photograph of sample point 23 (Table 3, Figure 39).

Exotic tree plantations: Section 1 has plantations of pine, eucalyptus, and cypress at the northern end. The mature trees of some plantations have been harvested and their removal is on-going. Old debarking scars caused by elephant were present on some plantation trees, particularly pine. Fire is a threat to plantations. The roads through the plantations are in bad condition or impassible. Some plantations are partly harvested with large logs left on the ground and partly over-grown by forbs and bush. A large herd of goats was encountered in one harvested plantations.
One area of indigenous tree enrichment planting was found (*ca*. S 00.42605; E 35.47898; 2,430 m asl). The survival rate of the seedlings is extremely low, probably as a result of over-browsing by livestock, particularly goats.

There is no natural forest outside of Section 1. Residents to the east of the W Mau FR boundary and the SW Mau FR 2001 excision boundary have planted a substantial number of trees for fuel wood

and poles. In some areas there are more trees outside these boundaries than inside. There are private plantations near the boundary, some of them covering several hectares. There are large numbers of exotic trees west of the SW Mau 2001 excision boundary; eucalyptus, pine, cypress, black wattle, grevillea, and others. Most of these were planted near homesteads from which encroachers were removed in 2009.

Diversity of medium and large mammals: Mammals which this study confirmed as present in Section 1, within 2.5 km to the west of the W Mau FR boundary and SW Mau FR 2001 excision boundary, are elephant, aardvark *Orycteropus afer*, Mau Forest guereza *Colobus guereza matschiei*, Stuhlmann's blue monkey *Cercopithecus mitis stuhlmanni*, crested porcupine, Egyptian mongoose *Herpestes ichneumon*, serval *Leptailurus serval*, southern tree hyrax *Dendrohyrax arboreus*, and hare *Lepus* sp. (Figure 53).

No recent sign of elephant was found in Section 1, and only one old sign of elephant was encountered (Figure 53). Nonetheless, interviewees claim that elephants cause substantial damage in the area. Officials at KWS in Kericho said that elephants come out of the SW Mau FR to raid crops during September-November. One resident claimed that the last time elephants came out of the SW Mau FR was in December 2015--near proposed Gate 3 (Table 6). Community leaders stated that past poaching of elephant was conducted by non-residents.

Spotted hyaena *Crocuta crocuta*, striped hyaena *Hyaena hyaena*, leopard, and bushpig *Potamochoerus larvatus* were not seen or heard in Section 1, but interviewees claimed hyaena and leopard killed their livestock, and that bushpigs damage their crops. We observed sites that appeared to have been dug-up by bushpigs.

Aardvark are common, based on the numerous aardvark holes encountered during foot surveys.

Figure 52. Aardvark *Orycteropus afer* holes are common in Section 1. This camera trap image of an aardvark was taken near Camp 4 (S 00.35418; E 35.44530; 2,412 m asl), South Western Mau Forest Reserve, on 10 January 2016 at 01:13 h (date in the image is incorrect).

The following mammals are among those that are expected to occur in Section 1, but which were not confirmed present during this study): common duiker *Sylvicapra grimmia* (confirmed for Section 2), yellow-backed duiker *Cephalophus silvicultor,* bushbuck *Tragelaphus scriptus*, honey badger *Mellivora capensis*, African golden cat, vervet monkey *Chlorocebus pygerythrus,* potto *Perodicticus potto*, northern lesser galago *Galago senegalensis* (present at Kericho Forest Station), African civet

Viverra civetta, genet *Genetta* sp., palm civet *Nandinia binotata*, white-tailed mongoose *Ichneumia albicauda*, zorilla *Ictonyx striatus*, and jackal *Canis* sp.

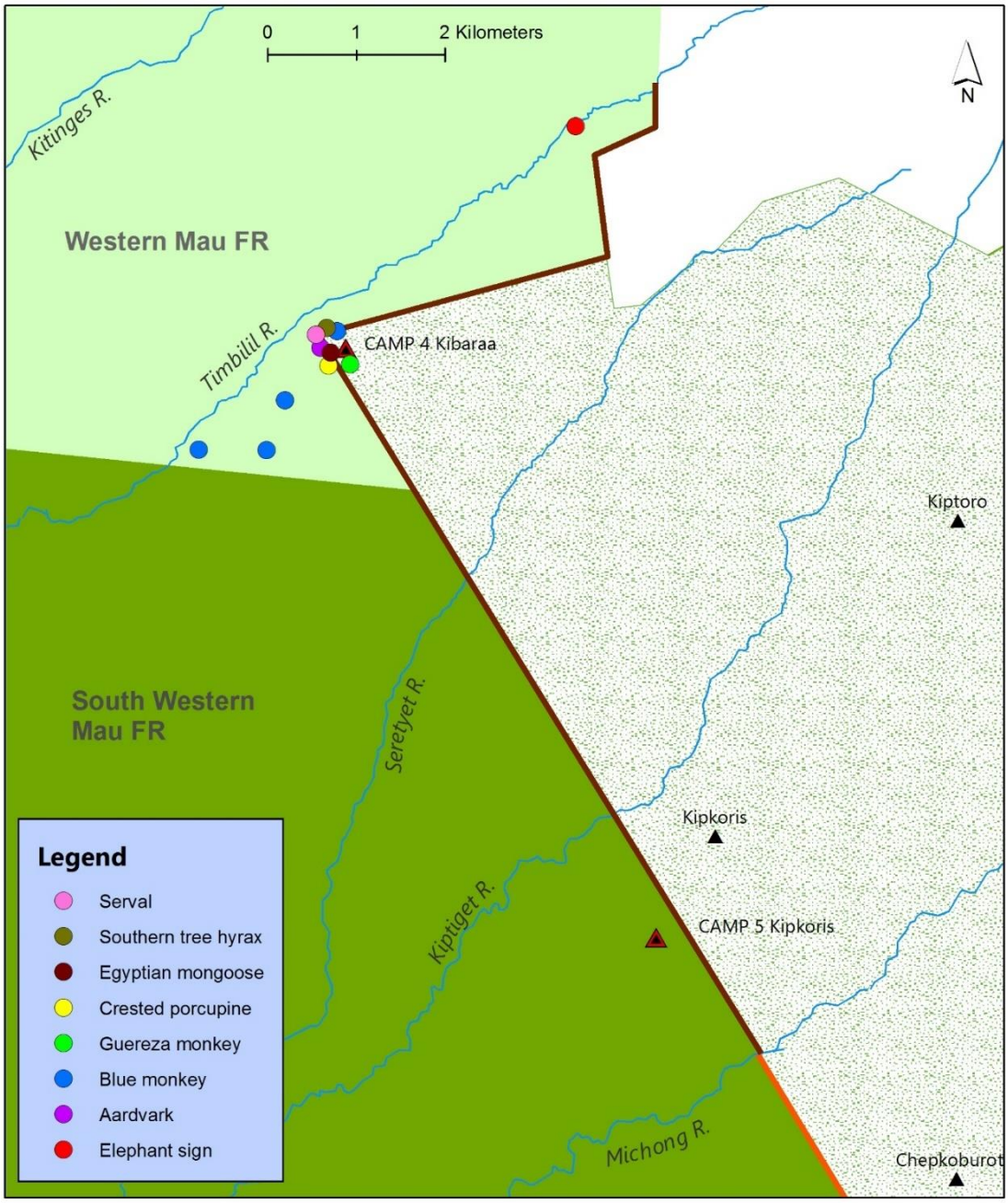


Figure 53. Records of medium and large mammals seen, heard and/or camera trapped in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve.

Apparently absent from Section 1 are olive baboon *Papio anubis*, buffalo, giant forest hog, and lion. It is likely that bongo is now absent from Section 1 within 2.5 km of the excision boundary due to the destruction of suitable habitat in this part of SW Mau FR.

Figure 54. Camera trap image of an Egyptian mongoose *Herpestes ichneumon* taken near Camp 4 (S 00.35343; E 35.44492; 2,387 m asl), South Western Mau Forest Reserve, on 11 January 2016 at 10:14 h (date in the image is incorrect).

Figure 55. Camera trap image of a serval *Leptailurus serval* taken near Camp 4 (S 00.35484; E 35.44630; 2,414 m asl), South Western Mau Forest Reserve.

Bird diversity: Fifty-four species of bird were encountered in Section 1. Bird abundance and the diversity of bird species in Section 1 was good, perhaps due largely to the high habitat heterogeneity. All species encountered were expected. The larger, fruit-eating species were surprisingly uncommon (*e.g.*, black-and-white-casqued hornbill *Bycanistes subcylindricus*, Hartlaub's turaco *Tauraco hartlaubi*, and red-fronted parrot *Poicephalus gulielmi*). This was likely due to the scarcity of large fruit trees in Section 1.

Figure 56. Camera trap image of a crested porcupine *Hystrix* sp. taken near Camp 4 (S 00.35418; E 35.44530; 2,412 m asl), South Western Mau Forest Reserve.

THREATS

Forest utilization, degradation, fragmentation, and loss in Section 1 is high and will certainly worsen given the lack of control of the taking of forest products. Illegal and unsustainable exploitation of forest products was observed during all foot surveys. Damage to the forest is particularly extensive and excessive within 2 km of the edge of the excision boundary. This included logging, fire, wood collection, charcoal-making, and grazing/browsing by cattle, sheep and goats. No undamaged, primary, forest remains. The area along the boundary north of the Michong River is particularly degraded. Here the natural forest has been entirely removed for 2 km from the excision boundary and tree seedlings have no chance of survival due to heavy browsing by livestock.

During foot surveys, no forest rangers or CFA members were encountered on patrol. Forest rangers moving with us on foot surveys, as well as those at Forest Stations, claimed that all people in the W Mau FR and SW Mau FR held valid grazing permits--but we never saw them ask herders to show their permits.

Encroachment: Encroachers were removed from Section 1 in 2009. No current encroachment was observed inside Section 1. Large areas of Section 1, to at least 2.3 km from the excise boundary, were encroached in the past and the evidence is still obvious and ample. Former farm plots, often demarcated by exotic trees, are now partly over-grown with bush or have become pasture. An Internally Displaced People (IDP) camp still exists at Kipkoris.

Charcoal: No fewer than 16 charcoal making sites (of all production stages) were located during foot surveys in Section 1 (Table 4, Figure 57). At least four additional active charcoal sites were detected from a distance, either by sight or by smell. There was much charcoal-making at the Timbilil River (Figure 57) in what appears to be the most important and biologically diverse forest remaining in Section 1. Section 1 had substantially more charcoal-making activity than Sections 2 or 3. Mean distance of charcoal-making activities from the excision boundary was 0.5 km (range 0.2-2.2). Standing on high ground over-looking Section 1, smoke from several charcoal-making pits was readily observed at dawn and, often, at other times of the day. Based on reports from forest rangers, leaders, and residents, charcoal is produced by non-residents. We observed no efforts by anyone to stop charcoal-making in Section 1.

Charcoal-making stage	Number of sites
Charcoal pit active	7
Charcoal pit recent	4
Charcoal pit old	2
Charcoal pile	3
Total	16

Table 4. Charcoal-making in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve.

"I normally report to the officials when I hear cutting of trees within the Reserve."
Jane Ruto

Figure 57. Sites where charcoal-making was observed during foot surveys in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve.

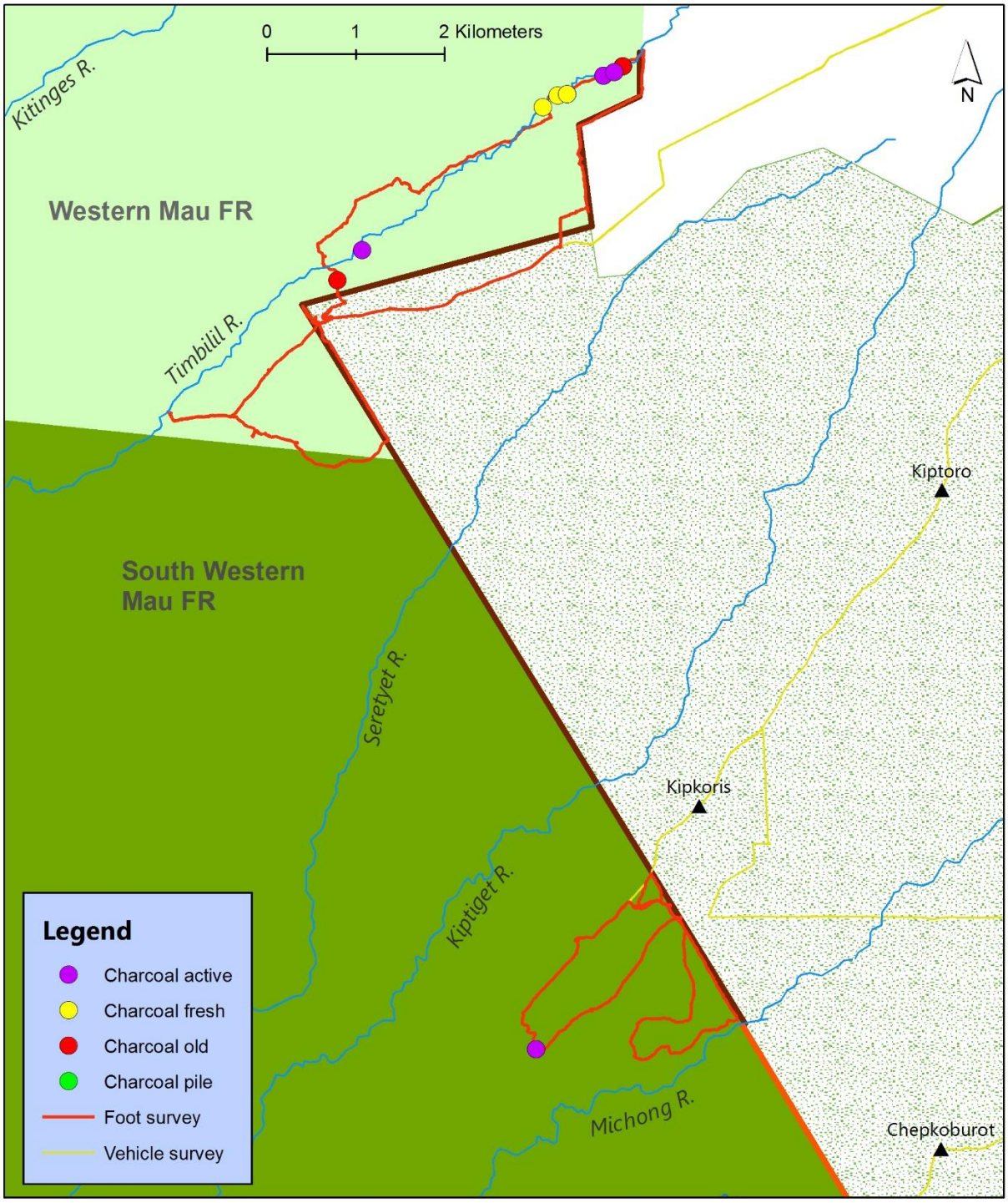


Figure 58. Charcoal-making at Timbilil River. This appears to be the most important and biologically diverse area of forest remaining in Section 1. Section 1 had substantially more charcoal-making activity than Sections 2 or 3.

Poaching: No evidence of poaching was observed in Section 1. This may be because there are few animals here to hunt. This is likely the result of the severe habitat degradation, loss, and fragmentation, and of past poaching.

Wood removal: Firewood removal from Section 1 is extensive. Debarking with the aim to kill trees or to collect the bark for traditional bee hives was observed. Cutting of small and medium sized trees occurs throughout Section 1, but is most common within 1.5 km of the excision boundary. Bamboo poles are cut for making fences and to provide support for mud-covered buildings. The few trees left by the encroachers within 2.5 km of the excision boundary are being cut. Thus, there are far fewer large trees in this area now than when the encroachers were evicted in 2009.

Figure 59. Firewood removal from Section 1 of the South Western Mau Forest Reserve is extensive. Note the complete absence of large trees in what was once an area of closed canopy montane forest. The unsustainable removal of forest products in this area continues.

Wood removal	Number of sites
Fresh-cut stumps	18
Wood piles	1
Debarking	2
Tree cutting	2
People with poles	0
People with firewood	4
Firewood piles	1

Table 5. Wood removal in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve.

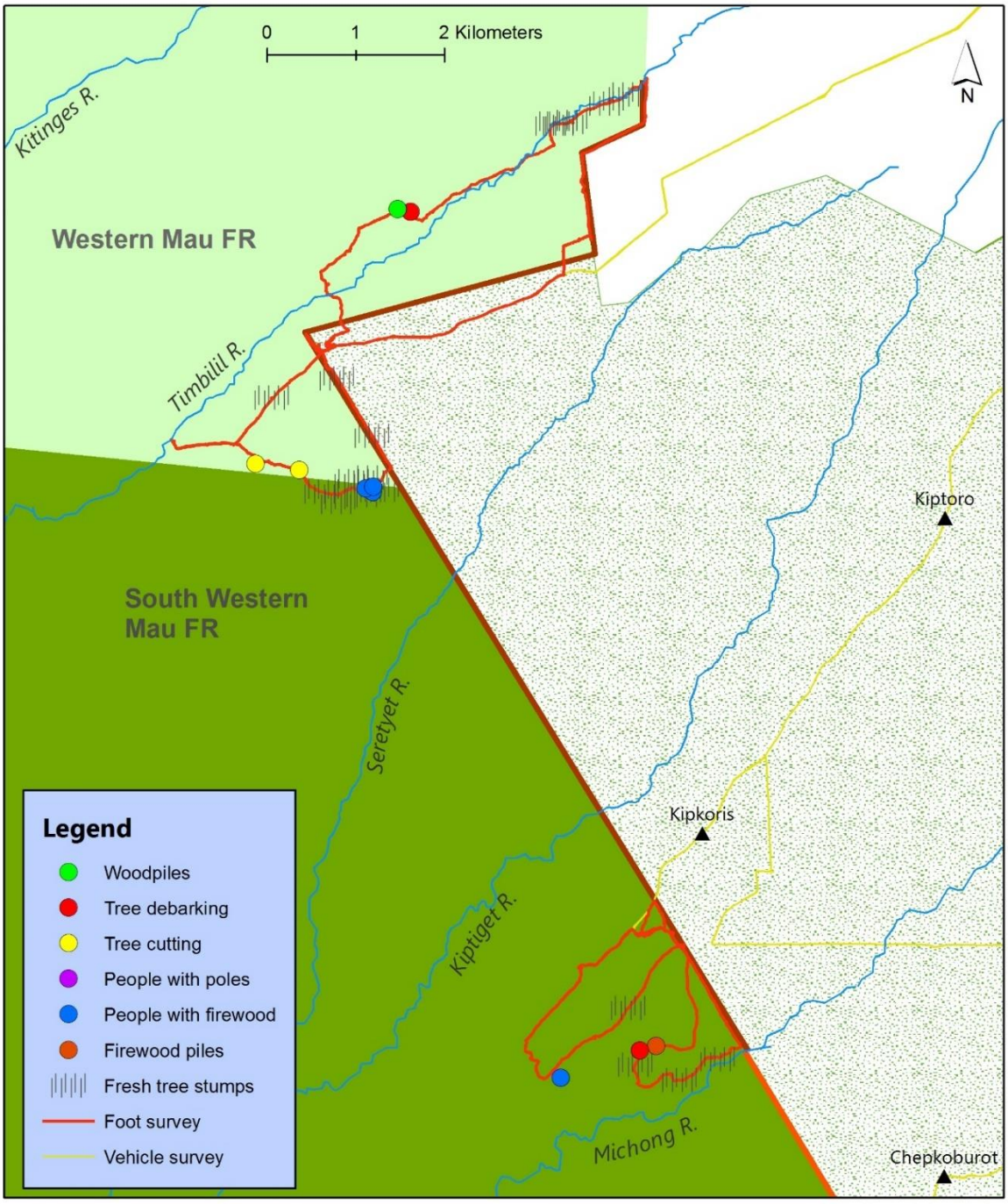


Figure 60. Sites where wood removal was observed during foot surveys in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve. As wood removal was common on the 2001 excision boundary, those many records are not depicted on this map.

Livestock: Grazing and browsing by cattle, sheep, and goats in Section 1 is extremely common and widespread in W Mau FR and SW Mau FR. Heavily used, often seriously degraded, livestock tracks are present to >2 km from the excision boundary. Severe soil erosion and the low density, or lack, of tree seedlings and saplings of some indigenous species indicate both extreme over-grazing and over-browsing. Livestock were observed to 2.3 km into the SW Mau FR from the excision boundary. Aerial surveys, however, readily find livestock >12 km into the SW Mau FR from the excision boundary. In

other words, livestock are present in the centre of the SW Mau FR. What has happened here is that the large area of the SW Mau FR that were encroached upon, settled, and converted to cropland, has now been converted to heavily grazed and browsed livestock pasture, bushland, and woodland. The intense over-browsing of the woody vegetation in Section 1 by livestock is both (1) preventing natural regeneration of the forest and (2) has led to the failure of schemes to plant indigenous trees.

Cattle and sheep were the most often encountered livestock in Section 1, but goats were also common. Although KFS does not supply grazing permits for goats, seven herds of goats were encountered in Section 1 (Figure 62). Although heavily grazed and browed by livestock, Sections 2 and 3 are not as severely damaged by livestock as is Section 1, nor do they hold such a high density of goats.

Livestock are typically left, unattended, in the W Mau FR and SW Mau FR from early morning to late afternoon. According to KFS rangers, all people within the reserve have grazing permits. We, however, never observed our ranger guides asking herders for grazing permits. This was the case even when rangers were with us in areas with which they were not familiar and, therefore, could not possible know the owners or the livestock we encountered. Of the many activities occurring in Section 1, livestock grazing and browsing is the most damaging to the forest.

Figure 61. Although the Kenya Forest Service does not supply grazing permits for goats, seven large herds of goats were encountered in Section 1.

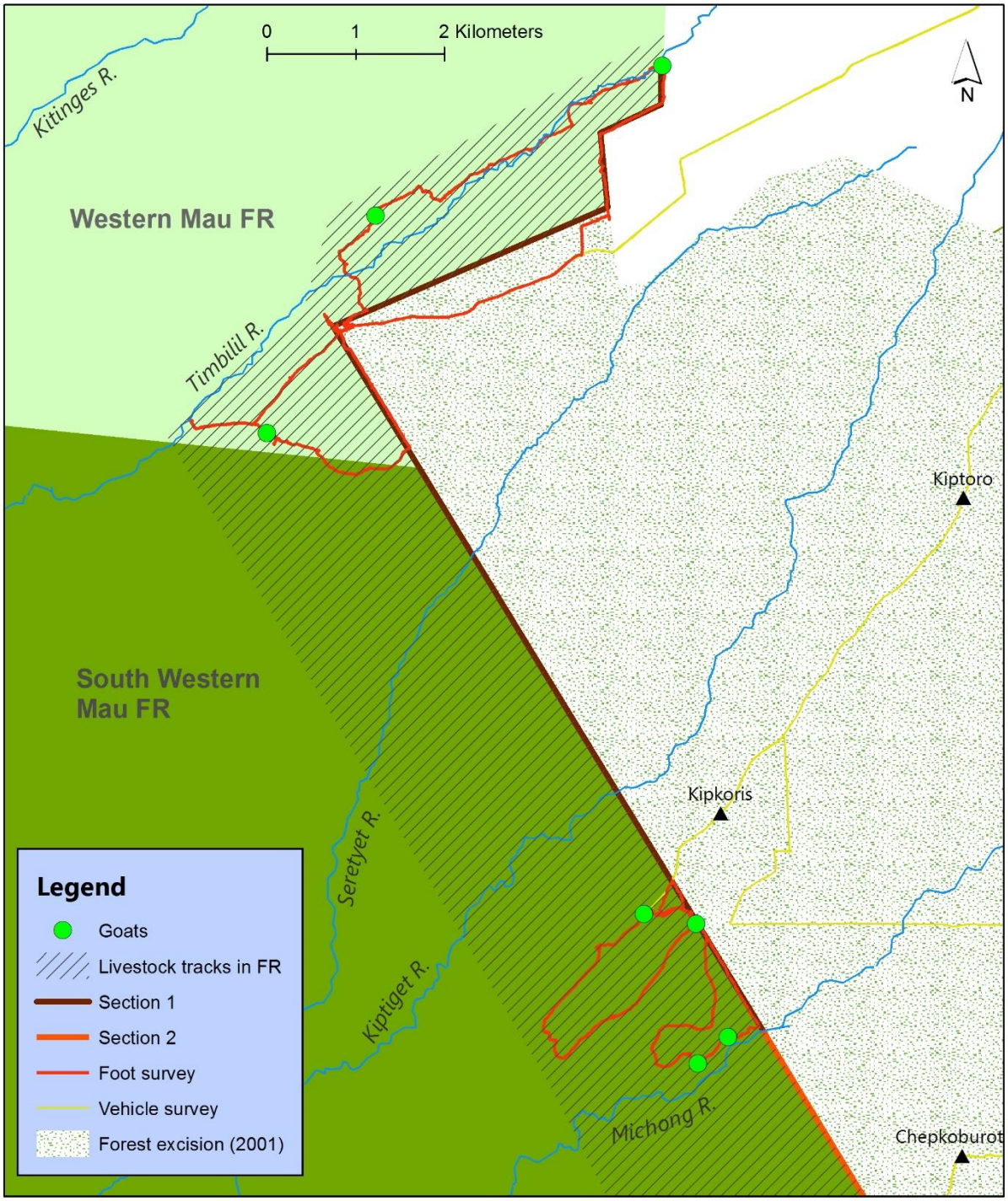


Figure 62. Sites where herds of goats were encountered during foot surveys in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve.

Fire: During foot surveys, an area of *ca*. 1.2 ha was found that burnt in 2015 (Figure 63). According to one resident, this fire was started by honey collectors. Other parts of Section 1 appear to have burnt in the past 5 years. Local leaders believe that fires (most often started by honey collectors) is a major threat to the forest in Section 1.

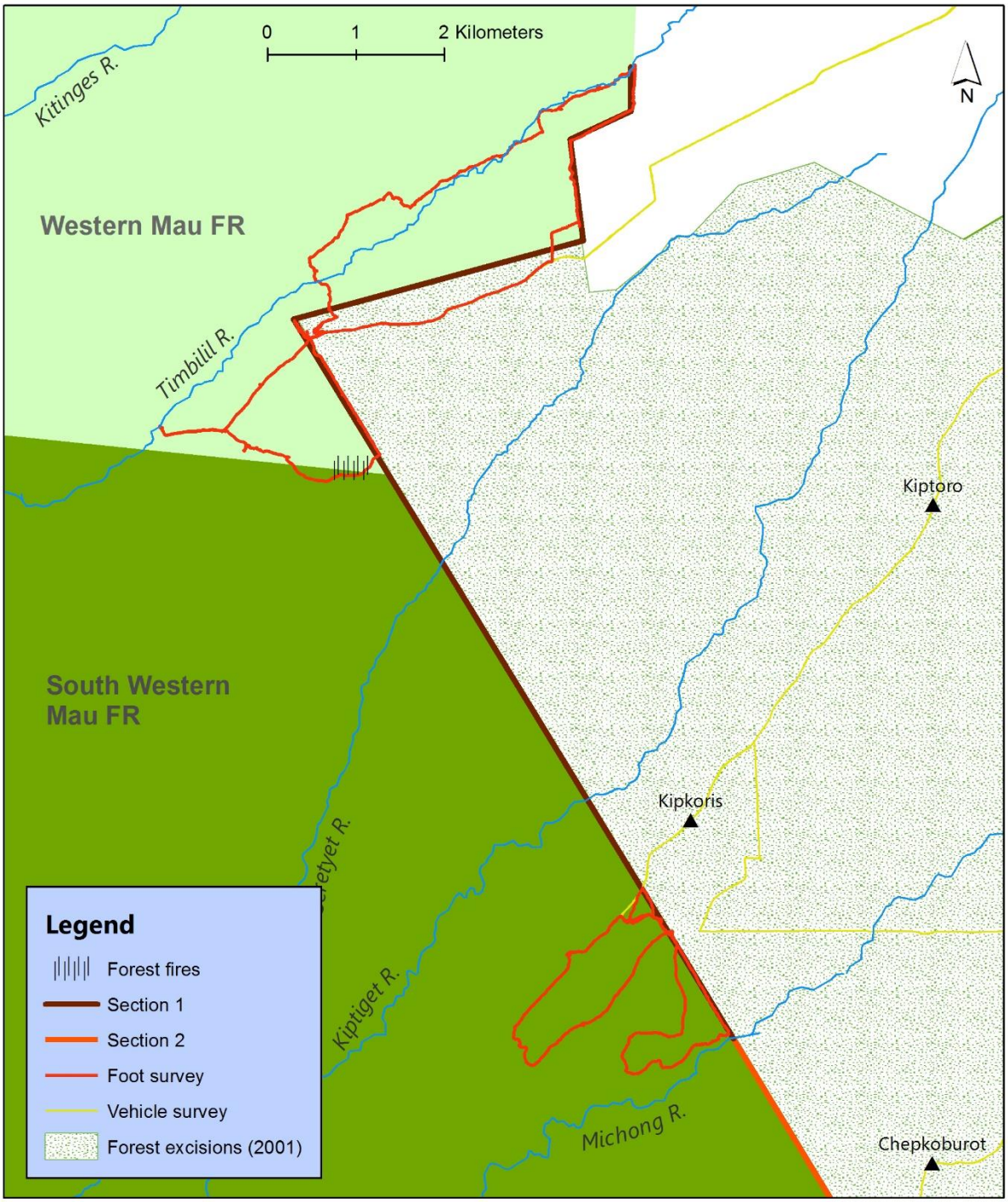


Figure 63. Area where a recent fire occurred in Section 1 of Western Mau Forest Reserve and South Western Mau Forest Reserve. Burnt trees, and dead and standing trees, encountered during foot surveys, or viewed from distant vantage points, provide evidence of past fires over much of Section 1.

ELECTRIC FENCE

Placement: The extreme over-exploitation, both past and present, observed in Section 1 of W Mau FR and SW Mau FR makes it clear that the only way the Government of Kenya will gain control of the area, and allow for the forest to recover some of its conservation values, is through placement of a game-

proof electric fence. It is, therefore, strongly recommended that an electric fence be constructed (Figure 65).

The game-proof electric fence should start 1.3 km north of the Timbilil River (S 00.32720; E 35.47933; 2,360 m asl) in the W Mau FR, and follow the eastern boundary of the W Mau FR until it reaches the excision boundary of the SW Mau FR (S 00.34330; 35.47368; 2,440 m asl). The fence then follows the straight excision boundary of the SW Mau FR to the Michong River (S 00.42605; E 35.48928; 2,378 m asl) (Figure 65). There is no compelling reason for any part of the W Mau FR or the unexcised SW Mau FR to lie outside of the fence. The total length of the fence for Section 1 is *ca.* 16.2 km (*ca.* 8.8 km for W Mau FR and *ca.* 7.4 km for SW Mau FR).

Compared to other sites in Kenya where a game-proof electric fence has been erected, the construction of the fence for Section 1 will not be particularly challenging. The Timbilil River area is moderately rugged/steep, but construction of a fence here should not be a problem.

The positive and negative impacts of a game-proof electric fence are summarized on pages 38 - 41.

Access gates: All of the fence-line is close to heavily-used footpaths and roads that come from the local communities up to the fence-line. These offer many good sites for the establishment of access gates. Local communities should be consulted as concerns the exact placement of all gates.

"Forest conservation brings us rainfall, fresh air, and a good environment." Wesley K Kirui

Figure 64. Proposed site for pedestrian/vehicle Access Gate 2 in Western Mau Forest Reserve.

We propose that five access gates be placed along the electric fence of Section 1; four pedestrian gates and one pedestrian/vehicle gate. Mean distance between gates is 2.8 km (range 1.6-4.0 km; Figure 65). Major considerations as to the number of gates for Section 1 are that (1) there are already a large numbers of private woodlots in the area (some of them very large), and (2) the vast majority of local people are currently meeting their wood needs from sources east of this fence-line.

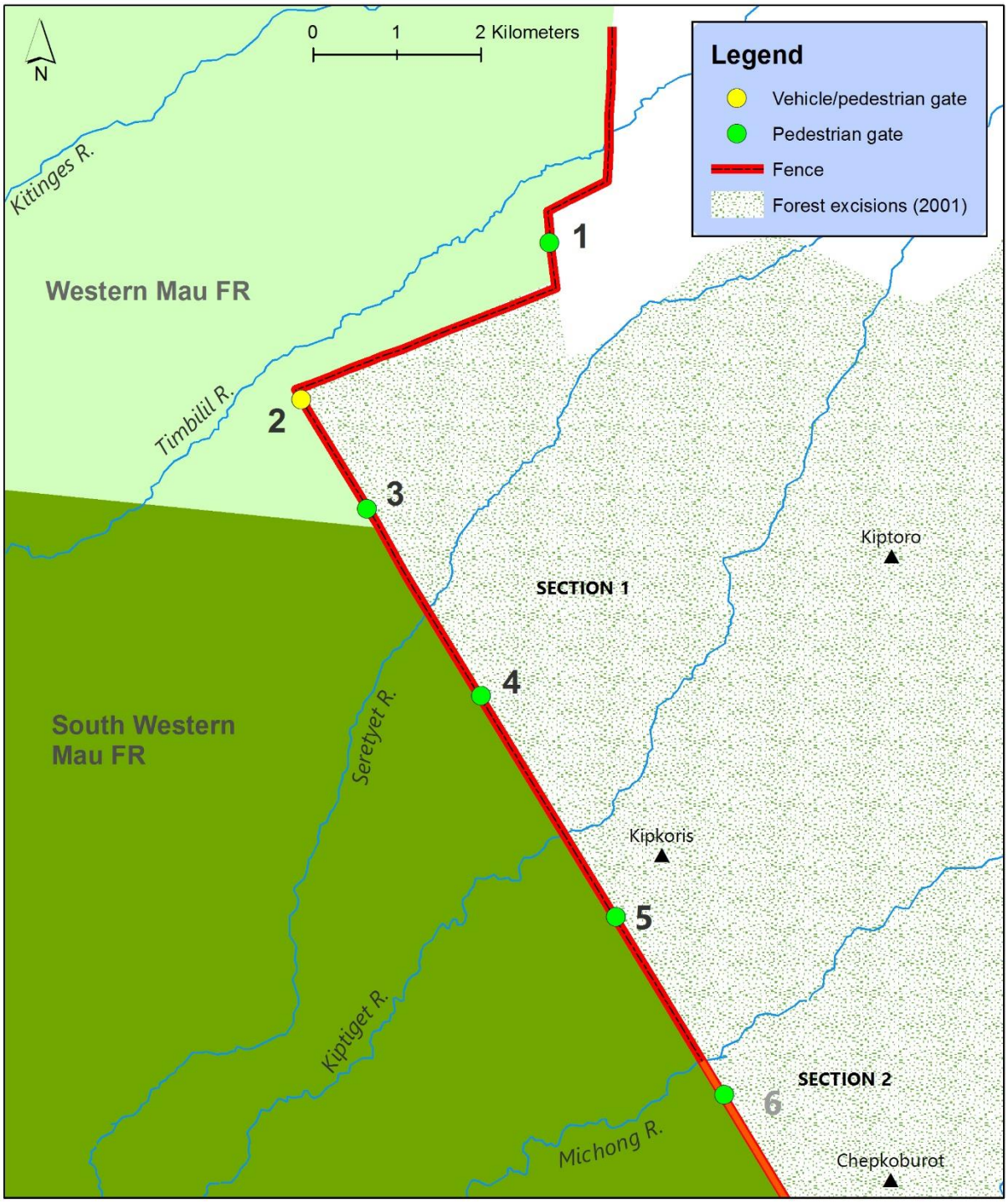


Figure 65. Location of the proposed comprehensive game-proof electric fence with wire mesh and five access gates for Section 1 of the Western Mau Forest Reserve and South Western Mau Forest Reserve. The fence begins at S 00.32720; E 35.47933; 2,360 m asl.

Gate	Type of gate	Coordinates	Altitude (m asl)
1	Pedestrian	S 00.338; E 35.473	2,399
2	Pedestrian/vehicle	S 00.355; E 35.446	2,406
3	Pedestrian	S 00.367; E 35.453	2,439
4	Pedestrian	S 00.387; E 35.466	2,411
5	Pedestrian	S 00.411; E 35.480	2,450

Table 6. Proposed locations and type of access gates for the game-proof electric fence in Section 1 of the Western Mau Forest Reserve and South Western Mau Forest Reserve (see Figure 65).

There are several old logging roads into Section 1, most of which are in poor condition. Since logging indigenous forest in Kenya is no longer legal, there is no need for vehicle access to most parts of Section 1. Gate 1.2 is a pedestrian/vehicle accesses gate for the road that leads to Kericho town and to tea plantations in that area.

These five gates will allow local people controlled access to the forest to remove, in a sustainable manner, those products that they most want (*e.g.*, grass, firewood, bamboo, honey, medicines). See the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012).

Situation outside the fence: Outside (east) of the proposed fence-line for Section 1, land that was excised in 2001 is today under dense human settlement, cropland, and pasture. Residents of this area have been there for, on average, *ca.* 13 years, and some for 20 years (since 1996). Although no significant areas of natural forest remain on the excised land, most of the excised land has a denser tree cover (indigenous and exotic tree species) than on the west side of the excision boundary. Most, if not all, residents have planted exotic trees on and around their plots, and some own tree plantations near the excision boundary.

Fence design: Given (1) that there is intensive agriculture on the edge of this section of the W Mau FR and SW Mau FR, that (2) the forest here continues to be unsustainably exploited by people and is not recovering from past encroachment, that (3) the large mammals responsible for most of the human-wildlife conflict reside within the Forest Reserves, and (4) that the terrain is not particularly challenging to construction of a fence, the fence all along Section 1 should be of the Comprehensive Game-proof Electric Fence with Wire Mesh design. This design will greatly reduce movement from the forest to the farmlands and settlements of the largest mammals (*e.g.,* elephant, buffalo, bushpig, leopard), as well as the larger burrowing mammals (*e.g.*, porcupine, hyaena, aardvark).

CONCLUSIONS

Placement of a game-proof electric fence in Section 1 is strongly supported by the heads of households who live within 1 km of the W Mau FR boundary and SW Mau FR excision boundary. An electric fence is also supported by local officials and leaders. This electric fence is expected to (1) nearly eliminate human-wildlife conflict in the area; (2) allow for recovery of this most valuable of Kenya's natural assets; (3) help maximize the benefits of the forest to the local people and to the nation; (4) ensure the long-term survival of this forest and its conservation values, and (5) help protect

the narrow, threatened, corridor that connects W Mau FR to SW Mau FR (Figures 3 & 65).

See pages 159 - 160 for additional conclusions that apply to Section 1.

Figure 66. South Western Mau Forest Reserve 2001 excision boundary at Kipkoris. Note that the excised area (right of the boundary line) has more tall trees than the Forest Reserve (left).

RESULTS SECTION 2: MICHONG RIVER to KIPSONOI RIVER

BACKGROUND

Location: Section 2 (Figures 67 & 68) begins at the Michong River (S 00.42608; E 35. 489286; 2,378 m asl) and runs southeastwards, along the eastern boundary of the SW Mau FR excision boundary to the Kipsonoi River (S 00.50628; E 35.53793; 2,339 m asl).

Most of Section 2 lies within the area covered by the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012). Some of the finding found during this study mirror well those presented in the Itare Participatory Forest Management Plan, particularly those findings concerned with how local people utilize the resources of the SW Mau FR...and would like to continue to utilize the SW Mau FR.

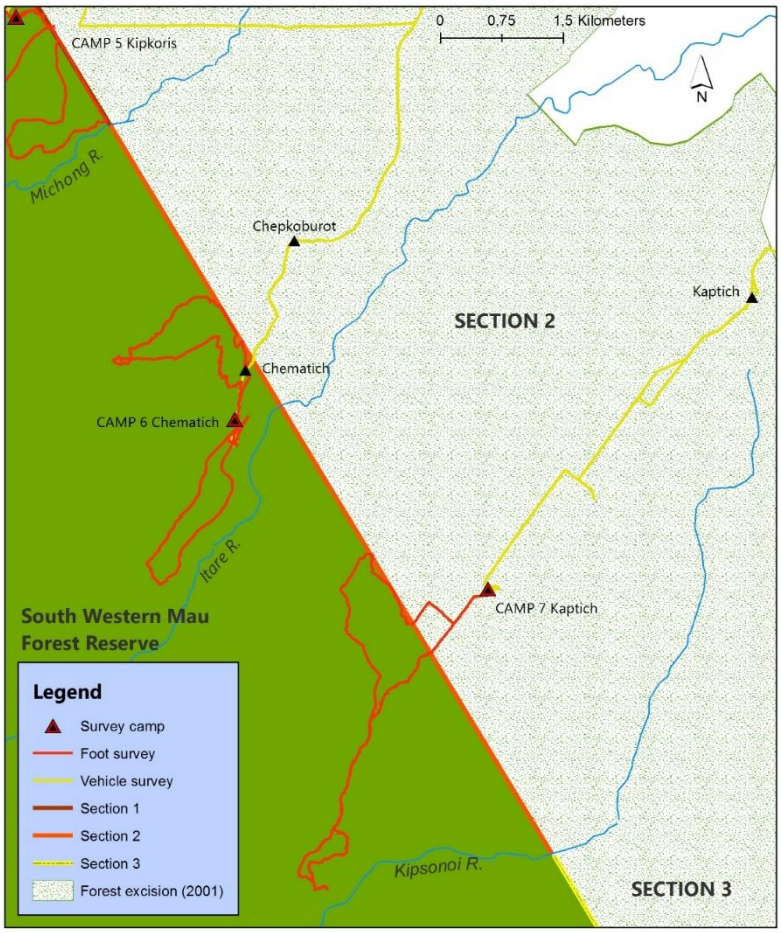


Figure 67. Section 2 of the study area in South Western Mau Forest Reserve.

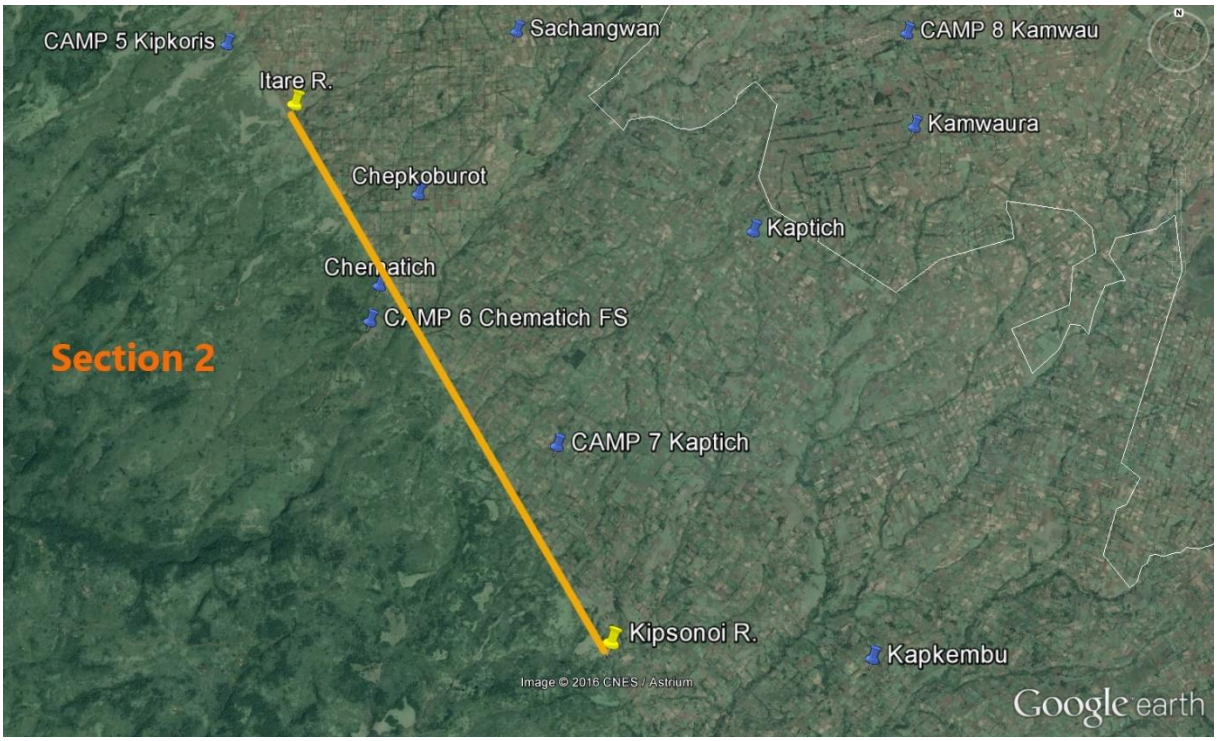


Figure 68. Location of Section 2 (orange line) in South Western Mau Forest Reserve on a Google Earth map. The orange line is the South Western Mau Forest Reserve 2001 excision boundary. The area to the east (right) is heavily settled and under intensive agriculture. The area to the west is heavily degraded montane forest and pasture.

Length: Section 2 has a length of *ca.* 10.4 km (measured using ArcGIS).

Purpose: Evaluate Section 2 for placement of a game-proof wildlife barrier. This barrier is expected to (1) reduce the level of human-wildlife conflict in the area; (2) protect a large and vital watershed; (3) reduce degradation, fragmentation, and destruction of SW Mau FR; and (4) allow for the long-term sustainable use of forest products.

This study establishes socio-economic, human-wildlife conflict, forest exploitation, and environmental baselines against which to assess change.

SOCIO-ECONOMIC ENVIRONMENT

Human population and land use:

Number of people interviewed:

- Heads of household: 94
- Officials and leaders: 7

"With a fence, the forest will be protected and there will be plenty of rain." David Ruto

Head of household interviewee profile:

- Mean duration on farm: 17.2 years (range <1-42)
- Mean number of people in household: 7.4 people (range 2-14)
- Mean distance of farm from excision boundary: 132 m (range 2-1000)
- Mean size of farm: 3.7 acres (range 0.3 – 10.0) (Figure 69)
- Three main crops:
  - maize (n=90)
  - potatoes (n=84)
  - beans (n=57)
  - wheat (n=23)
- Mean number of livestock per farm: 15.4 head (range 1-64) (Figure 69)
- The human population of Section 2 is high. Farm plots are exclusively within the excised area. Farms are right up to the SW Mau FR excision boundary.

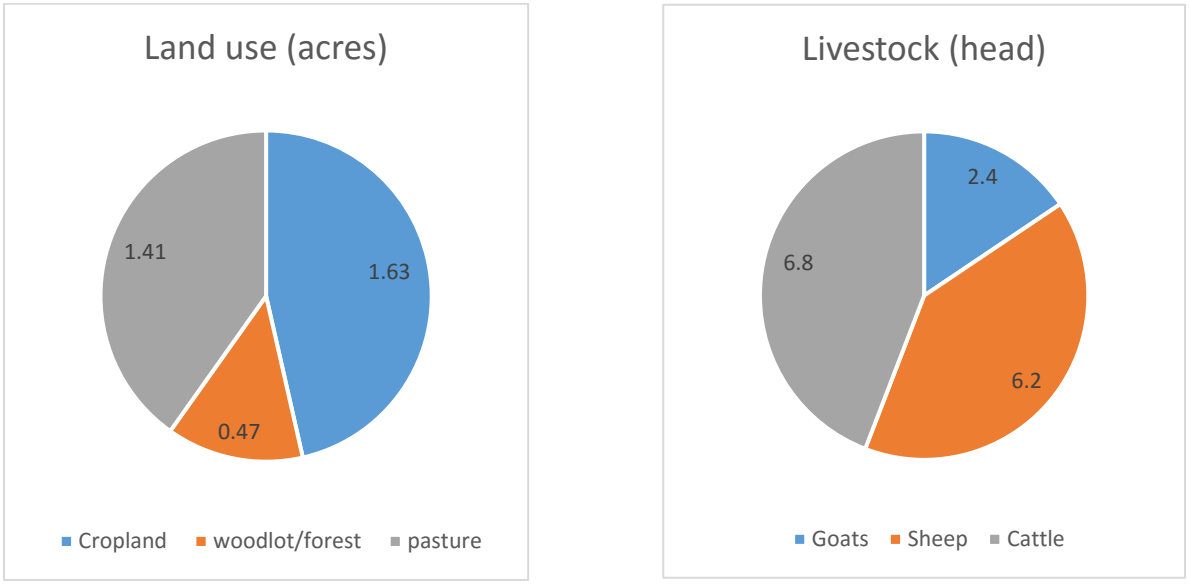


Figure 69. Main types of land-use and numbers of livestock on the average farm in Section 2 of South Western Mau Forest Reserve according to the heads of households (n=94).

HUMAN-WILDLIFE CONFLICT

Damage by wildlife to crops, livestock and infrastructure (*e.g.*, fences, buildings) is a main concern of heads of households (n=94). Officials and leaders (n=7) shared this concern, but to a substantially lesser extent (Figure 70). Officials and leaders, as well as community members, claimed they had 'a lot' of crop damage, livestock loss and damage to infrastructure by wildlife in Section 2.

Crop damage:

- Heads of households: 83% said 'a lot'
- Officials and leaders: 43% said 'a lot'

Livestock loss:

- Heads of households: 73% said 'a lot'
- Officials and leaders: 43% said 'a lot'

"Some of my sheep have not healed yet from a hyaena attack." Evalyn Chepkurui

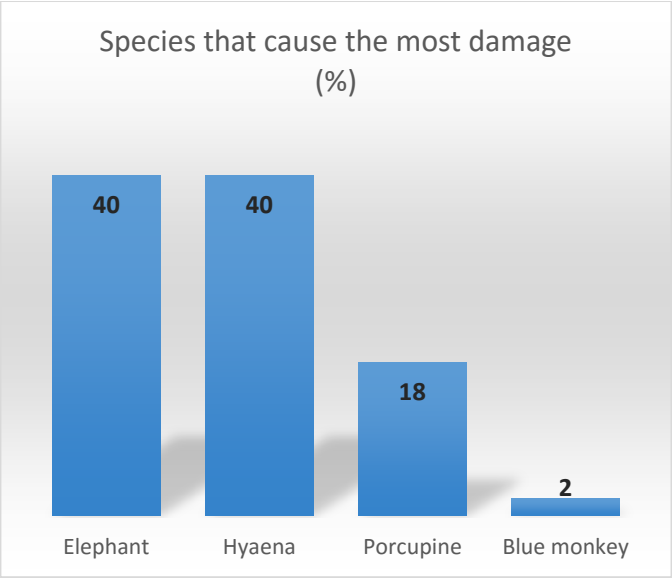
Damage to infrastructure:

- Heads of households: 84% said 'a lot'
- Officials and leaders: 57% said 'a lot'

Figure 70. Crop damage, livestock loss, and damage to infrastructure by wildlife in Section 2 of South Western Mau Forest Reserve according to the heads of households (n=94), and officials and leaders (n=7).

The wild animal species which cause the most damage in Section 2, according to the heads of households, are elephant, hyaena, and crested porcupine (Figure 71).

To stop wildlife from inflicting damage, interviewees (n=94) said that they use noise (78%), fire (35%), dogs (13%), and chase species (11%). Only one interviewee said she reports cases of human-wildlife conflict to KWS or KFS.



"The fence will provide safety of both forest and my farm."
Joseph Kipsigei Arap Kitel

Figure 71. Species of wildlife which, according to the heads of households (n=42), cause the most damage in Section 2 of South Western Mau Forest Reserve. The number at the top of each bar represents the percentage of heads of households who said that species causes the most damage.

UTILIZATION OF THE FOREST RESERVE

All households (n=94) in Section 2 use the SW Mau FR to some extent, and almost all use the Forest Reserve 'a lot'. They use the SW Mau FR 'a lot' for grazing (94%), medicines (88%), firewood (80%), and honey (59%; Figure 72). Heads of households claim that they do not use the SW Mau FR for charcoal, lumber, or meat. No person said they get water from the SW Mau FR. These results suggest that there is ample charcoal, lumber, meat, and water outside the SW Mau FR. See the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012) for additional information on how the local people use the SW Mau FR in the Section 2 area.

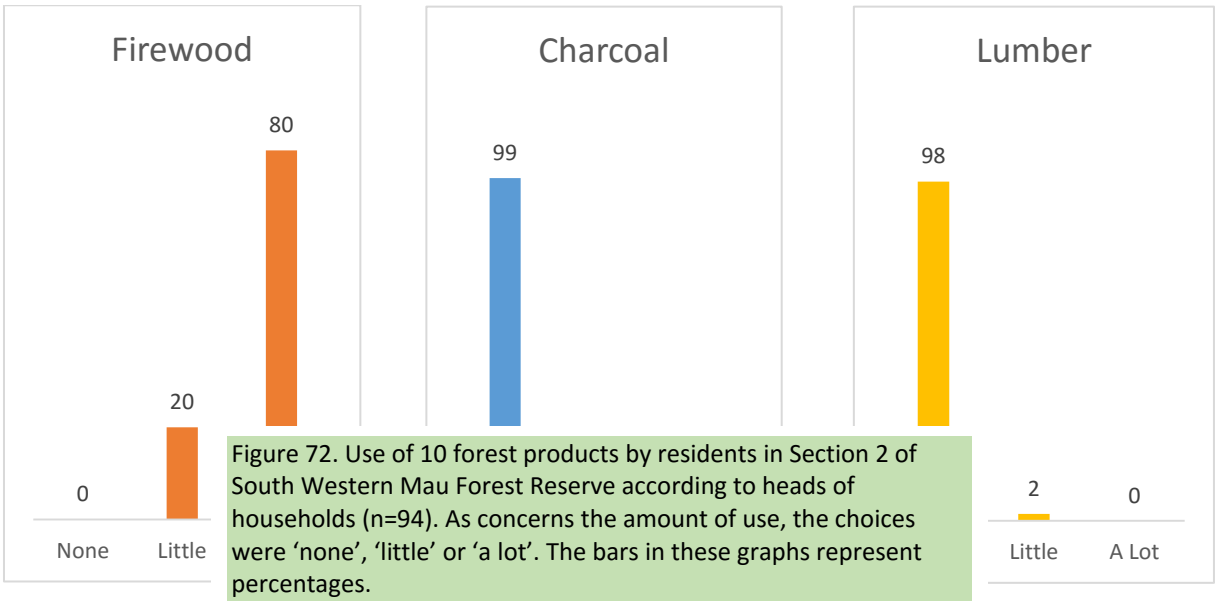
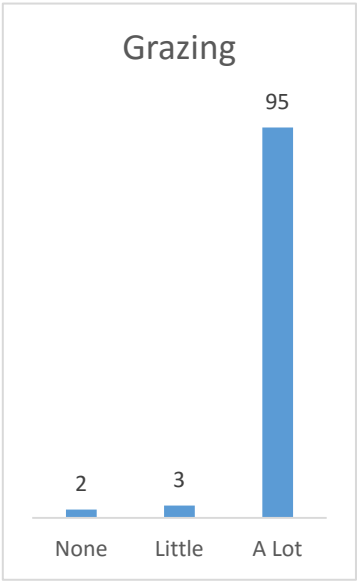
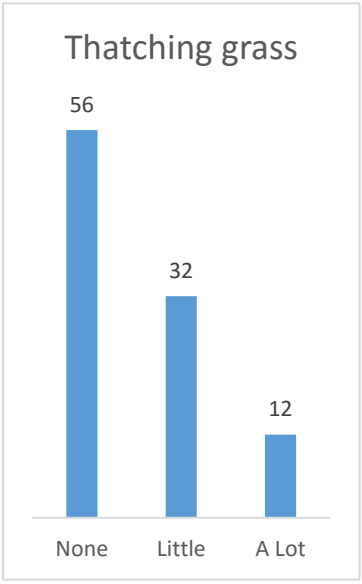
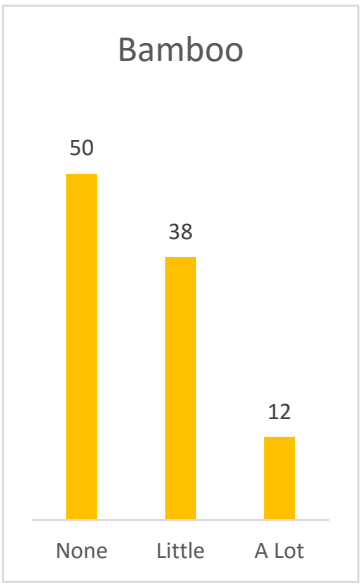
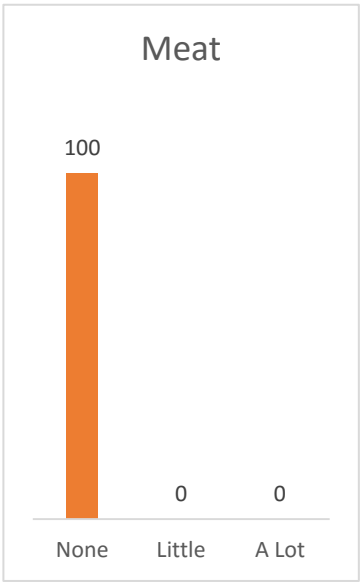


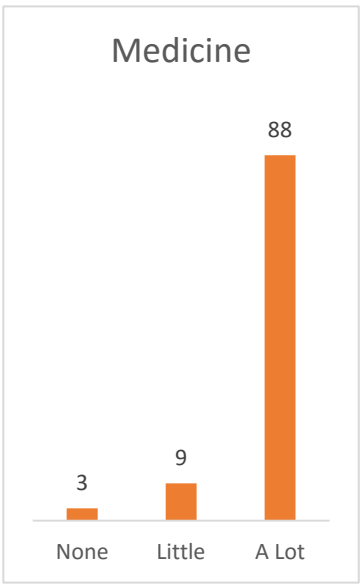
Figure 72. Use of 10 forest products by residents in Section 2 of South Western Mau Forest Reserve according to heads of households (n=94). As concerns the amount of use, the choices were 'none', 'little' or 'a lot'. The bars in these graphs represent percentages.

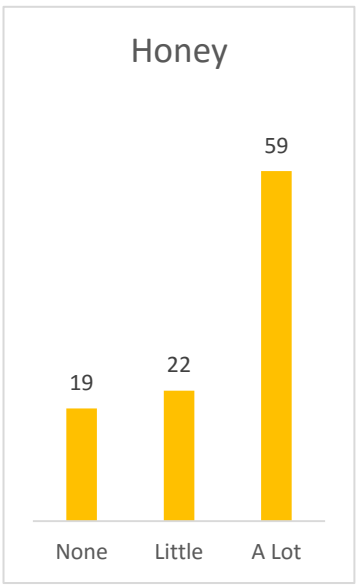


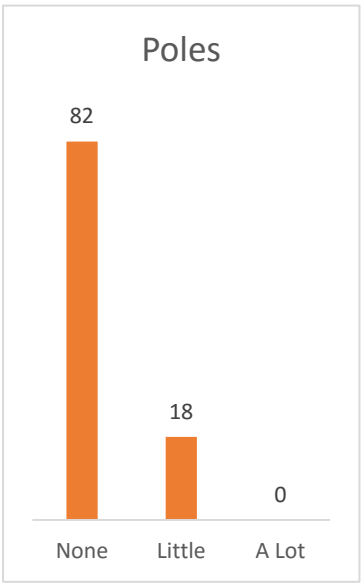












"Already we have tea plantations but animals still manage to reach our homesteads." Richard Kirui

ATTITUDES TOWARDS A BARRIER

Ninety-nine percent of the heads of households (n=94) said that they would be 'happy' if an electric fence were constructed, while 1% was 'neutral' to the concept. While the respondents understood that the fence would greatly limit the level of illegal exploitation of the SW Mau FR, they were positive about the potential reduction in damage by wildlife to their crops, livestock, and infrastructure. Seventy-two percent of officials and leaders (n=7) said they would be 'happy' with an electric fence, 14% said they would be 'unhappy' with a fence, and 14% had 'no opinion'. Many leaders and residents who attended the barazza, including members of the Ogiek tribe, said they were supportive of a fence (as a group they were divided) but needed more time and wanted to consult more members of the community to provide a final answer.

During the barazza some people said that they were not certain about the exact location of the excision boundary. Some leaders and residents expressed concerned about the safety of an electric fence for their children and livestock.

The reasons given for local support of an electric fence included reduced damage by wildlife, reduced poaching of wild animals, less movement of people into the Forest Reserve, and less forest destruction, particularly as a result of charcoal-making. Interviewees also mentioned the job opportunities the construction and maintenance of a fence would bring. All interviewees believed there will be enough people within the community willing and able to help with construction and maintenance of the fence.

Figure 73. The barazza at Kaptich on 18 January 2016 was attended by about 50 people from the community, including leaders, elders, and officials.

When heads of households (n=94) were asked, "Do you prefer a Nyayo Tea Zone or an electric fence as a barrier for the South Western Mau Forest Reserve?", 97% said "fence", 1% said "Tea Zone", and 2% said "no opinion". Seventy-one percent of the officials and leaders (n=7) said they prefer an electric fence and 29% preferred a tea zone. The people at the barazza were divided in their opinion. In general, people believe that, compared to a Nyayo Tea Zone, a fence would (1) be more effective in reducing human-wildlife conflict; (2) be more effective for forest protection; (3) give residents more access to forest products; and (4) provide more jobs. Overall, interviewees believed a fence would be a more permanent solution to their problems with wildlife and with conserving the forest. The one interviewee who preferred a Nyayo Tea Zone said that it would provide more jobs for woman and young people. Some of the leaders who attended the barazza preferred a Nyayo Tea Zone over an electric fence, their main concern being the 'danger of

electricity'.

All interviewees of the Head of Household Questionnaire and of the Officials and Leaders Questionnaire, as well as those people who attended the barazza, said forest conservation is important. They believed that the best way to protect the SW Mau FR from further degradation and destruction is through a combination of electric fencing, conservation education, community participation, people working more closely with CFAs, additional forest rangers, improved permit system, increased patrols by forest rangers and community members, and planting trees.

During the barazza it became clear that additional CFAs are required in Section 2, and that the CFAs that are in place are weak and in need of strengthening.

PHYSICAL ENVIRONMENT

Altitude: The altitudinal range along the SW Mau FR excision boundary is 2,340-2,450 m asl. Overall, the terrain is rather flat with gently sloping valleys where streams flow. In Section 2, ca 12 streams/rivers (including the Michong Itare, Kipsonoi Rivers) flow out of the Forest Reserve.

Rainfall: Mean annual rainfall over Section 2 is *ca.* 1,300 mm (WRI, 2007).

Soil: The soil in Section 2 is described as "*well drained, extremely deep, dark reddish–brown, friable and flightly smeary clay, with an acid humic topsoil*" (Sombroek *et al.*, 1982).

Figure 74. Heavily used, severely eroded, livestock trails near the 2001 excision boundary of Section 2.

Suitability of the terrain for an electric fence: The terrain along the entire proposed Section 2 barrier line is suitable for construction of an electric fence. Given that all of the boundary was once within an encroached area, few trees would need to be removed in order to clear the 7-10 m-wide strip required by an electric fence.

BIOLOGICAL ENVIRONMENT

Vegetation: Section 2 lies within the 'East African Montane Forest Ecoregion' (WWF, 2004). Much of the montane forest that once occurred within 3 km west of the excision boundary has been destroyed or extremely degraded. There are now large areas of fragmented secondary forest, bush, poor bamboo, short-grass glades, and erosion gullies.

Figure 75. Much of the montane forest that once occurred within 3 km west of the South Western Mau Forest Reserve 2001 excision boundary has been destroyed and turned into intensively used pasture. Projects that planted indigenous trees in these areas did poorly, or failed, as a result of over-browsing by livestock.

The more common indigenous trees in Section 2 that were identified during this study are the colonizing, secondary forest, species *Croton macrostachyus Hypericum revolutum, Macaranga kilimandascharica, Neoboutonia macrocalyx, Dodonaea augustifolia*, *Acacia albida, Nuxia congesta,* and *Faurea saligna.*

Other indigenous tree species identified during this study are *Podocarpus latifolius, Cassia* sp, *Polyscias kikuyuensis*, *Drypetes gerrardii*, *Tabernaemontana stapfiana, Aningeria adolfi-friederici, Dombeya goetzenii, Hagenia abyssinica, Psychotria mahonii, Acacia albida, Casaeria battiscobei, Allophylus abyssinicus, Albizia gummifera, Albizia gummifera,* and *Schefflera volkensii,*

Exotic trees species present are *Pinus* sp., *Eucalyptus* spp., *Cupressus lusitanica, Acacia melanoxylon,* and *Grevillea robusta.*

Other plants identified during this study are *Rubus* sp., *Arundinaria alpina, Vernonia auriculifern, Pteridium aquilinum, Senecio* sp., *Acanthus eminens, Solanum* spp., and *Rubus* sp.

Number	Date (2016)	Time (h)	Latitude	Longitude	Altitude (m)	Vegetation	Disturbance
24	13 January	10:20	S00.42944	E35.47855	2411	Natural forest with bushland and grassy glades. Better forest here than elsewhere. *Fauea* shrubs, some *Macaranga,* bracken, *Hypericum, Drypetes gerrardii*. Large eucalyptus, pine and cypress in	Heavily used pasture. Poor forest and degraded bushland. Rows of tall eucalyptus. Recently cut cypress.

						distance.	
25	14 January	11:47	S00.46265	E35.50024	2431	Natural forest and bush with bamboo. No pasture. Degraded forest.	Cow paths.
26	14 January	13:15	S00.47618	E35.49451	2380	Grass glade near pine plantation. Baken, black wattle, old shambas.	Heavily used pasture.
27	15 January	10:40	S00.44715	E35.50217	2463	Large are of pasture with braken, short bamboo, vernonia, *Dodonaea,* with scattered pine, cypress, eucalyptus, *Grevillia*.	Heavy grazing by livestock. Erosion. Garbage.
28	15 January	11:37	S00.44678	E35.49636	2418	Bushland with bamboo, braken, and scattered tall trees. Scattered small glades.	Heavily grazing by livestock and eroded livestock trails.
29	15 January	12:26	S00.45168	E35.49023	2417	Glade bordering dense bush with braken and bamboo. Regenerating trees, including *Tabernamontana, Macaranga, Dombeya, Pshychotria,* podo, cypress, eucalyptus, *Faurea, Hypericum, Croton.*	Abandoned shamba. Heavily used by livestock and people. Livestock nearby.
30	17 January	09:21	S00.48508	E35.52329	2380	Grassland and bushland with bamboo and brakenfern. Near stream.	Heavy use of pasture. Eroded livestock paths.
31	17 January	11:30	S00.50860	E35.51034	2393	Natural forest with patches of bamboo.	Much exploited secondary forest.

Table 7. Wood removal in Section 2 of the South Western Mau. Details of sample points in Section 2 of the South Western Mau Forest Reserve at which vegetation and disturbance were described (Figure 76).

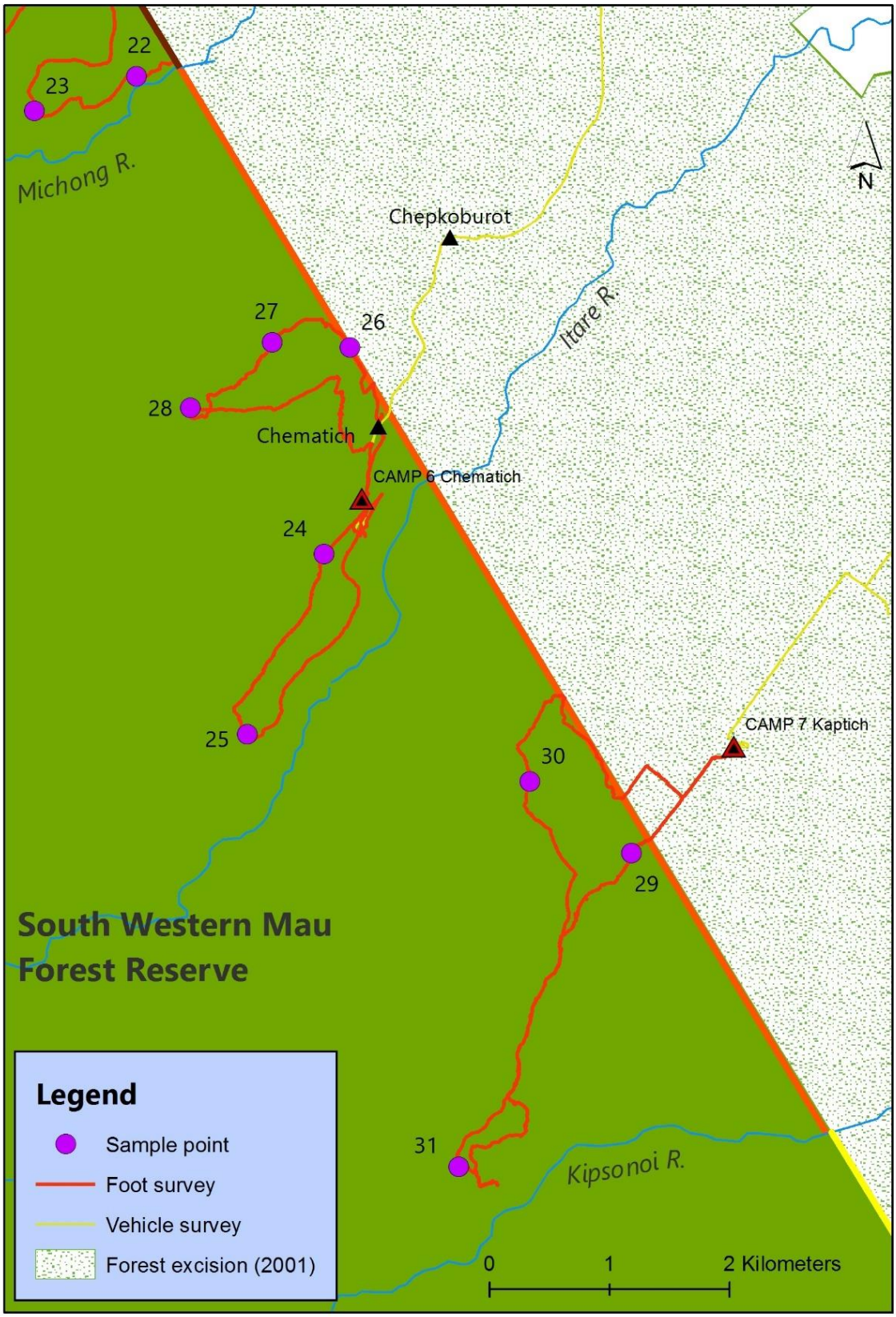


Figure 76. Locations of sample points in Section 2 of South Western Mau Forest Reserve at which vegetation and habitat disturbance were described (Table 7).

Figure 77. 360 degrees photograph of sample point 24 (Table 7, Figure 76).

Figure 78. 360 degrees photograph of sample point 25 (Table 7, Figure 76).

Figure 79. 360 degrees photograph of sample point 26 (Table 7, Figure 76).

Figure 80. 360 degrees photograph of sample point 30 (Table 7, Figure 76).

Figure 81. 360 degrees photograph of sample point 31 (Table 7, Figure 76).

Exotic tree plantations: Two private, illegal, exotic tree plantations were encountered during foot surveys in Section 2. One was 2.7 km west of the SW Mau FR eviction boundary at S 00.50992; E 35.51240; 2,355 m asl.

Figure 82. The indigenous tree enrichment projects in Section 2 of South Western Mau Forest Reserve have failed due to extensive over-browsing by livestock.

Two large areas of indigenous tree enrichment planting were found (*ca*. S 00.44618; E 35.49679; 2,415 m asl and *ca.* S 00.44618; E 35.49679; 2,430 m asl). Most of the seedling that were still alive had been severely browed. The survival rate of the seedlings is extremely low, probably as a result of over-browsing by livestock, particularly goats. The remains of the plastic bags that held the seedlings were often abundant.

There is no natural forest outside of Section 2. Residents to the east of the SW Mau FR excision boundary have planted a substantial number of trees for fuel wood and poles. There are large numbers of exotic trees west of the SW Mau excision line; eucalyptus, pine, cypress, black wattle, grevillea, and others. Most of these were planted near homesteads from which encroachers were removed in 2009.

Diversity of medium and large mammals: Mammals which this study confirmed as present in Section 2, within 2.5 km to the west of the SW Mau FR excision boundary (Figure 85), are elephant, aardvark, guereza monkey, Stuhlmann's blue monkey (Figure 83), common duiker (Figure 84), and spotted hyaena.

Figure 83. Adult male Stuhlmann's blue monkey *Cercopithecus mitis stuhlmanni* in South Western Mau Forest Reserve.

No recent sign of elephant was found in Section 2, and only one small dung bolus was encountered (Figure 85). Nonetheless, interviewees claim that elephants cause substantial damage in the area. Officials at KWS in Kericho said that elephants come out of the SW Mau FR to raid crops during September-November.

Leopard and bushpig were not seen or heard in Section 2, but interviewees claimed that bushpigs damage their crops. We observed sites that appeared to have been dug-up by bushpigs.

Aardvark are common, based on the numerous aardvark holes encountered during foot surveys.

The following mammals are among those that are expected to occur in Section 2, but which were not confirmed present during this study): yellow-backed duiker, bushbuck, honey badger, African

golden cat, potto, northern lesser galago, African civet, genet *Genetta* sp., palm civet, white-tailed mongoose, zorilla, southern tree hyrax, hare *Lepus* sp., and jackal *Canis* sp.

Forest rangers at Chematich Forest Station claimed that buffalo and bongo occur in Section 2 *ca.* 4 km inside SW Mau FR. Apparently absent from Section 2 are olive baboon, vervet monkey, giant forest hog, and lion.

Figure 84 . Common duiker *Sylvicapra grimmia* at Chematich, South Western Mau Forest Reserve. This camera trap image was taken near Camp 7 (S 00.47710; E 35.53094; 2,479 m asl) on 15 January 2016 at 10:27 h.

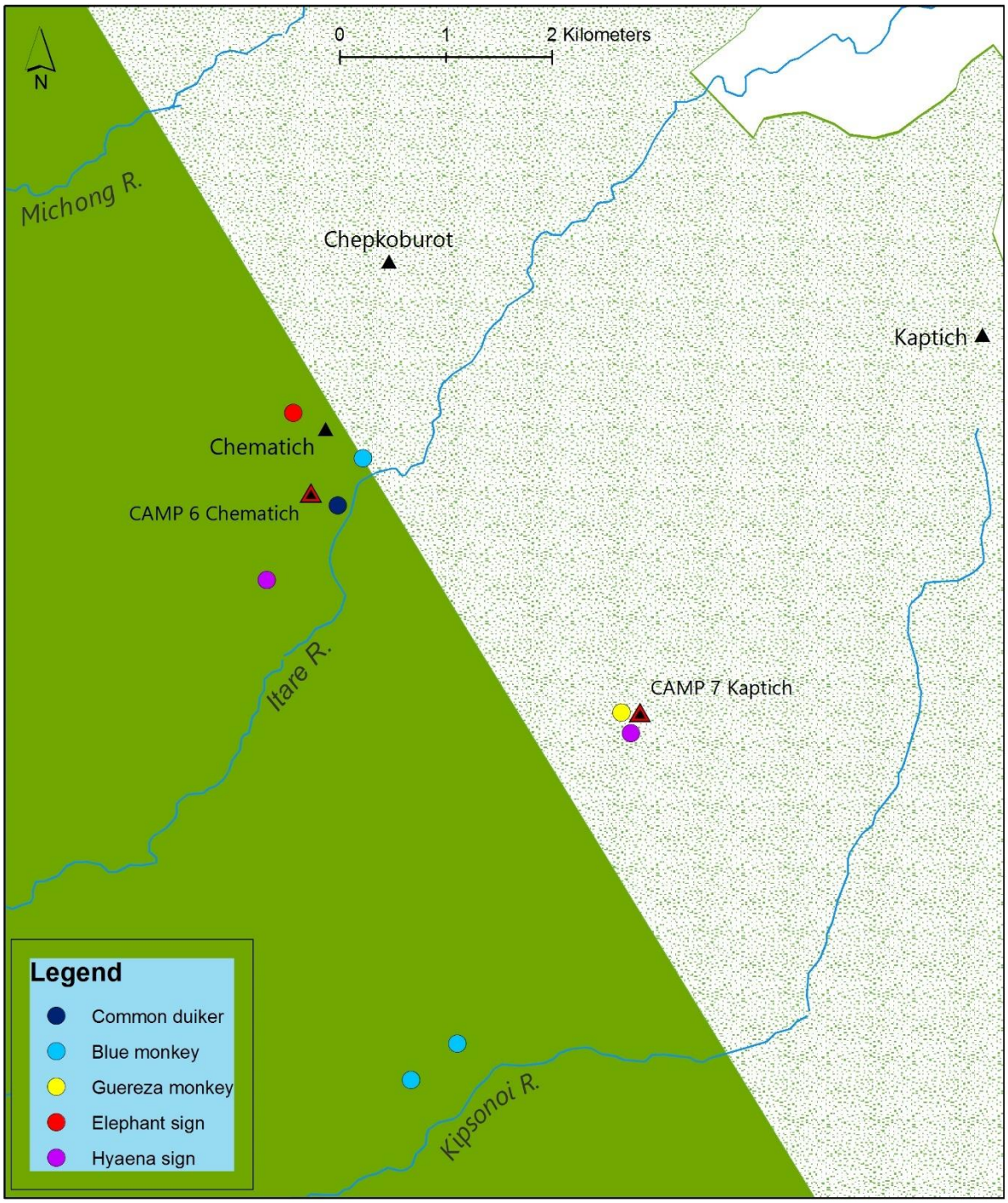


Figure 85. Records of medium and large mammals seen, heard and/or camera trapped in Section 2 of South Western Mau Forest Reserve.

Bird diversity: Forty-seven species of bird were encountered in Section 2. Of these, 22 species were not encountered in Section 1. Total number of bird species encountered in Sections 1 and 2 was 76. Black-and-white casqued hornbill and red-fronted parrot were noticeably absent, probably due to the scarcity of large fruiting trees. All species of bird encountered were expected to occur.

THREATS

Forest utilization, degradation, fragmentation, and loss in Section 2 is high and will certainly worsen given the lack of control of the taking of forest products. Illegal and unsustainable exploitation of forest products was observed during all foot surveys. Damage to the forest is particularly extensive and excessive within 2 km of the edge of the SW May Forest excision boundary. This included logging, fire, wood collection, charcoal-making, and grazing/browsing by cattle, sheep and goats. No undamaged, primary, forest remains. Most of the natural forest has been removed for 2 km from the excision boundary. Fragments of degraded natural forest are still present in the vicinity of S 00.483; E 35.520; 2,425 m asl. Outside these fragments, heavy browsing by livestock means that the seedlings of most tree species have little or no chance of surviving. The biggest threat to the regeneration of the montane forest in Section 2 is over-browsing by livestock.

"With the fence the forest will be protected and there will be plenty of rain." David Ruto

During foot surveys, no forest rangers or CFA members were encountered on patrol. Forest rangers moving with us on foot surveys, as well as those at Forest Stations, claimed that all people in the SW Mau FR held valid grazing permits--but we never saw them ask herders to show their permits.

Encroachment: Encroachers were removed from Section 2 in 2009. No current encroachment was observed inside Section 2. Large areas of Section 2, to at least 2.7 km from the excise boundary, were encroached in the past and the evidence is still obvious and ample. Former farm plots, often demarcated by exotic trees, are now partly over-grown with bush or have become pasture. An Internally Displaced People (IDP) camp still exists at Kiletien (S 00.38607; E 35.53810, 2,555 m asl).

Figure 86. Internally Displaced People Camp at Kibaraa, Western Mau Forest Reserve.

Charcoal: One charcoal pile was located during foot surveys in Section 2 (Figure 87) but the smell of charcoal smoke was detected at a few other sites. Charcoal-making in Section 2 was not nearly are prevalent as in Section 1.

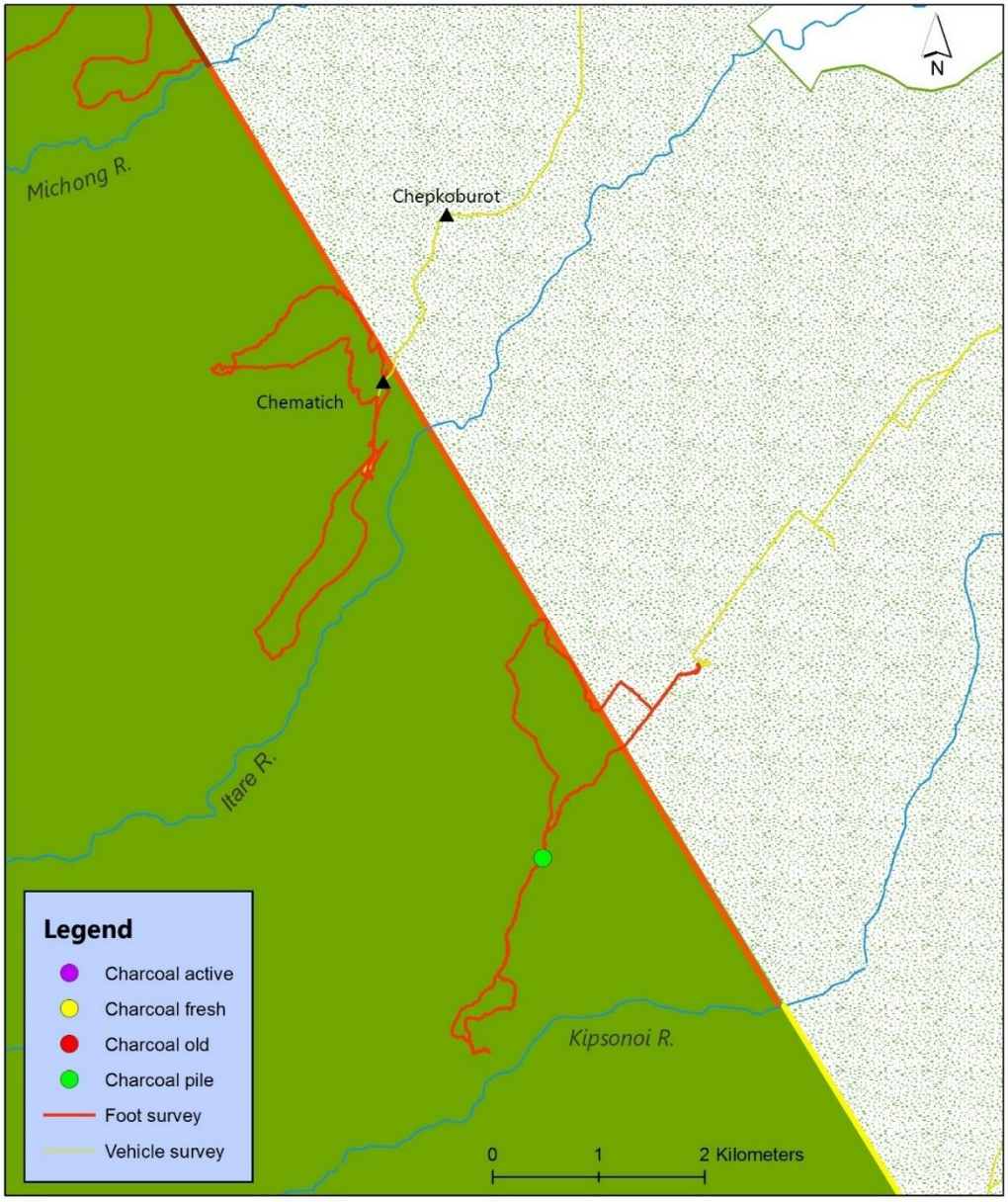


Figure 87. Sites where charcoal-making was observed during foot surveys in Section 2 of South Western Mau Forest Reserve.

Poaching: Three wire snare animal traps were found in Section 2. Section 2 is the only section where traps were found.

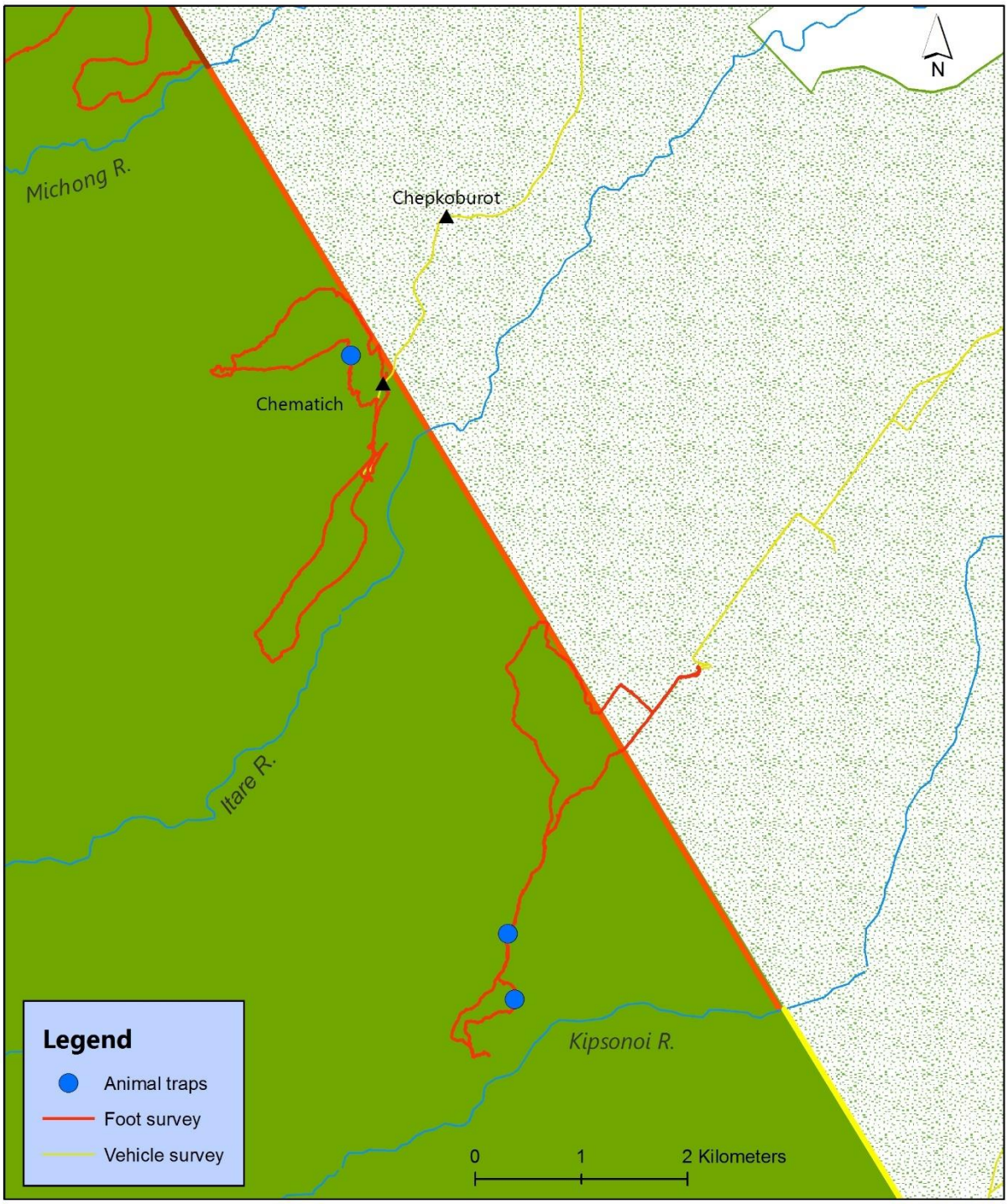
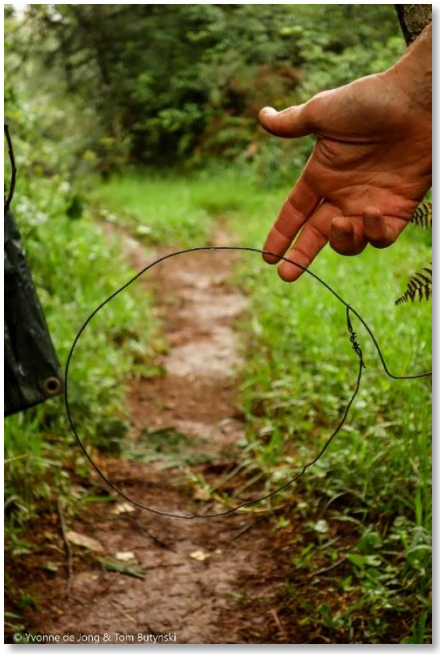


Figure 89. Sites where animal traps were observed during foot surveys in Section 2 of South Western Mau Forest Reserve.



"We need to involve the community on the Reserve boundary in the protection of the Mau Forest." Daisy Langat

Figure 90. Three wire snare animal traps were found in Section 2 of the South Western Mau Forest Reserve.

Wood removal: Firewood removal from Section 2 is extensive. Debarking with the aim to kill trees or to collect the bark for traditional bee hives was observed. Cutting of small and medium sized trees occurs throughout Section 2, but is most common within 1.5 km of the excision boundary. Bamboo poles are cut for making fences and to provide support for mud-covered buildings. The few trees left by the encroachers within 2.5 km of the excision boundary are being cut. Patches of black wattle in Section 2 are being harvested.

Figure 91. Debarking with the aim to kill trees or to collect the bark for traditional bee hives and medicines was observed in Section 2 of the South Western Mau Forest Reserve.

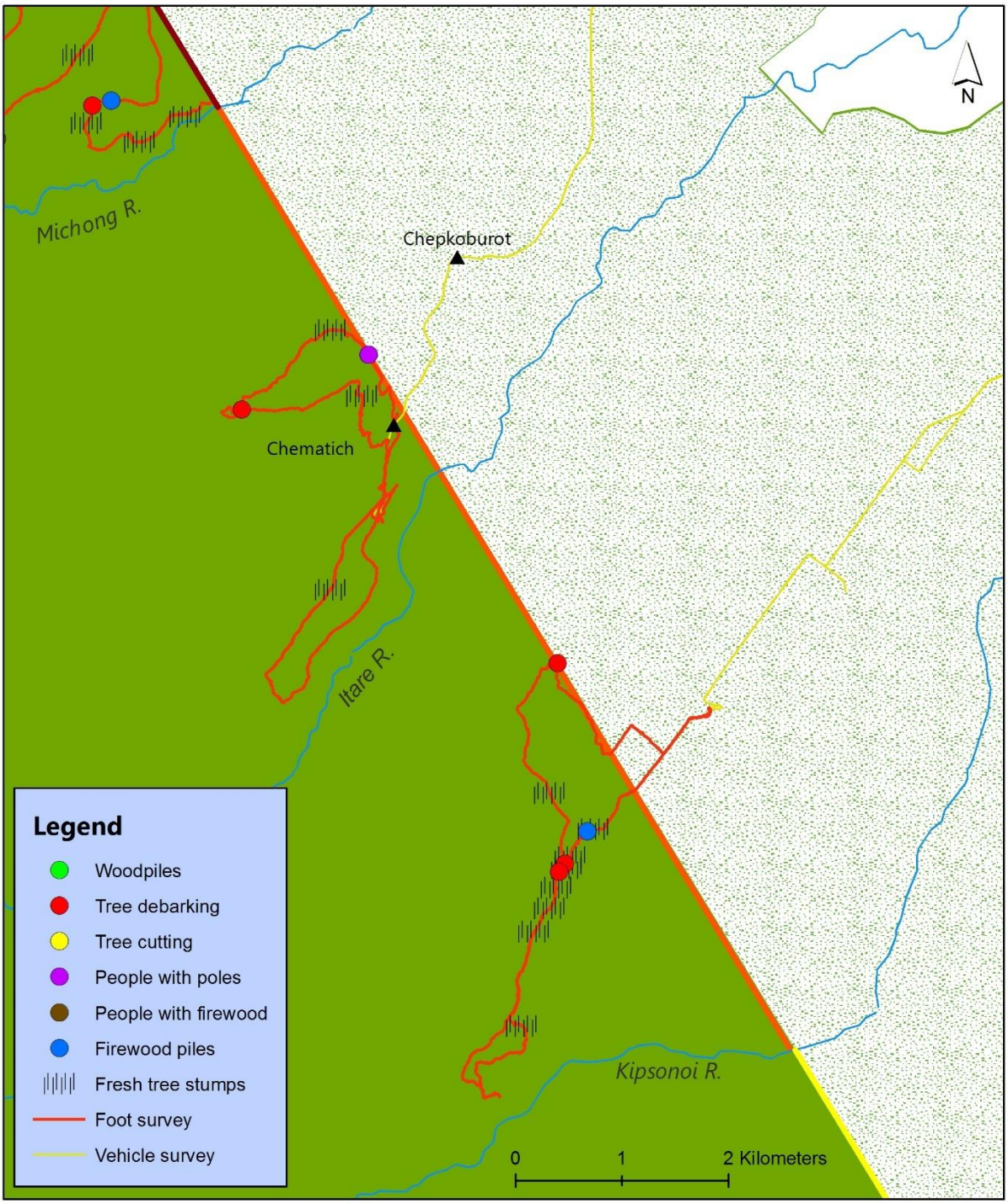


Figure 92. Sites where wood removal was observed during foot surveys in Section 2 of the South Western Mau Forest Reserve. As wood removal was common on the 2001 excision boundary, those records are not depicted on this map.

Table 8. Wood removal in Section 2 of the South Western Mau Forest Reserve.

Wood removal	Number of sites
Fresh-cut stumps	11
Wood piles	0
Debarking	4
Tree cutting	0
People with poles	1
People with firewood	1
Firewood piles	1

Livestock: Grazing and browsing by cattle, sheep, and goats in Section 2 is common and widespread in SW Mau FR. Heavily used, often seriously degraded, livestock tracks are present to >2 km from the excision boundary. Severe soil erosion and the low density, or lack, of tree seedlings and saplings of some indigenous species indicate both extreme over-grazing and over-browsing. Livestock were observed to 2.8 km into the SW Mau FR from the excision boundary. Aerial surveys, however, readily find livestock >12 km into the SW Mau FR from the excision boundary. In other words, livestock are present in the centre of the SW Mau FR. What has happened here is that the large area of the SW Mau FR that were encroached upon, settled, and converted to cropland, has now been converted to heavily grazed and browsed livestock pasture, bushland, and woodland. The intense over-browsing of the woody vegetation in Section 2 by livestock is both (1) preventing natural regeneration of the forest and (2) has led to the failure of schemes to plant indigenous trees.

Figure 93. Extensive livestock damage to *Faurea saligna* seedlings and saplings in Section 2 of the South Western Mau Forest Reserve.

Cattle and sheep were the most often encountered livestock in Section 2. Although KFS does not supply grazing permits for goats, one herd of goats were encountered in Section 2 (Figure 95). These goats were browsing the site of an indigenous tree enrichment planting scheme. Although heavily grazed and browed by livestock, Sections 2 is not as severely damaged by livestock as is Section 1, nor is the density of goats as high.

Figure 94. Heavily used and eroded livestock tracks are common to >2 km from the South Western Mau Forest Reserve 2001 excision boundary.

Livestock are typically left, unattended, in the W Mau FR and SW Mau FR from early morning to late afternoon. According to KFS rangers, all people within the reserve have grazing permits. We, however, never observed our ranger guides asking herders for grazing permits. This was the case even when rangers were with us in areas with which they were not familiar and, therefore, could not possible know the owners or the livestock we encountered. Of the many activities occurring in Section 2, livestock grazing and browsing is the most damaging to the forest.

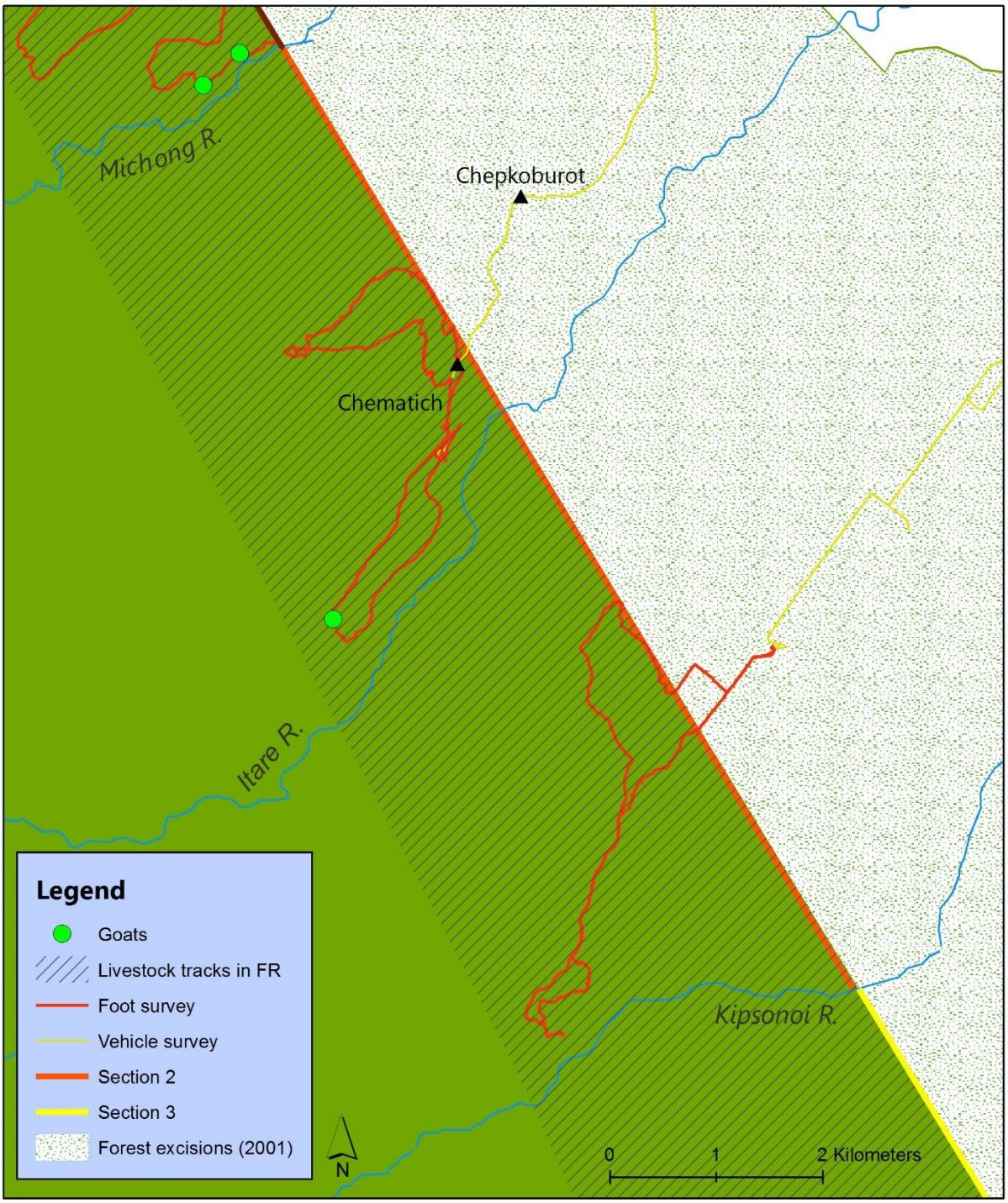


Figure 95. Site where a herd of goats were encountered during a foot survey in Section 2 of South Western Mau Forest Reserve.

Fire: During foot surveys, one burnt area was encountered (S 00.48182; E 35.51543; 2,440 m asl). Local leaders believe that fires are most often started by honey collectors, and that fire is a major threat to forest in Section 2.

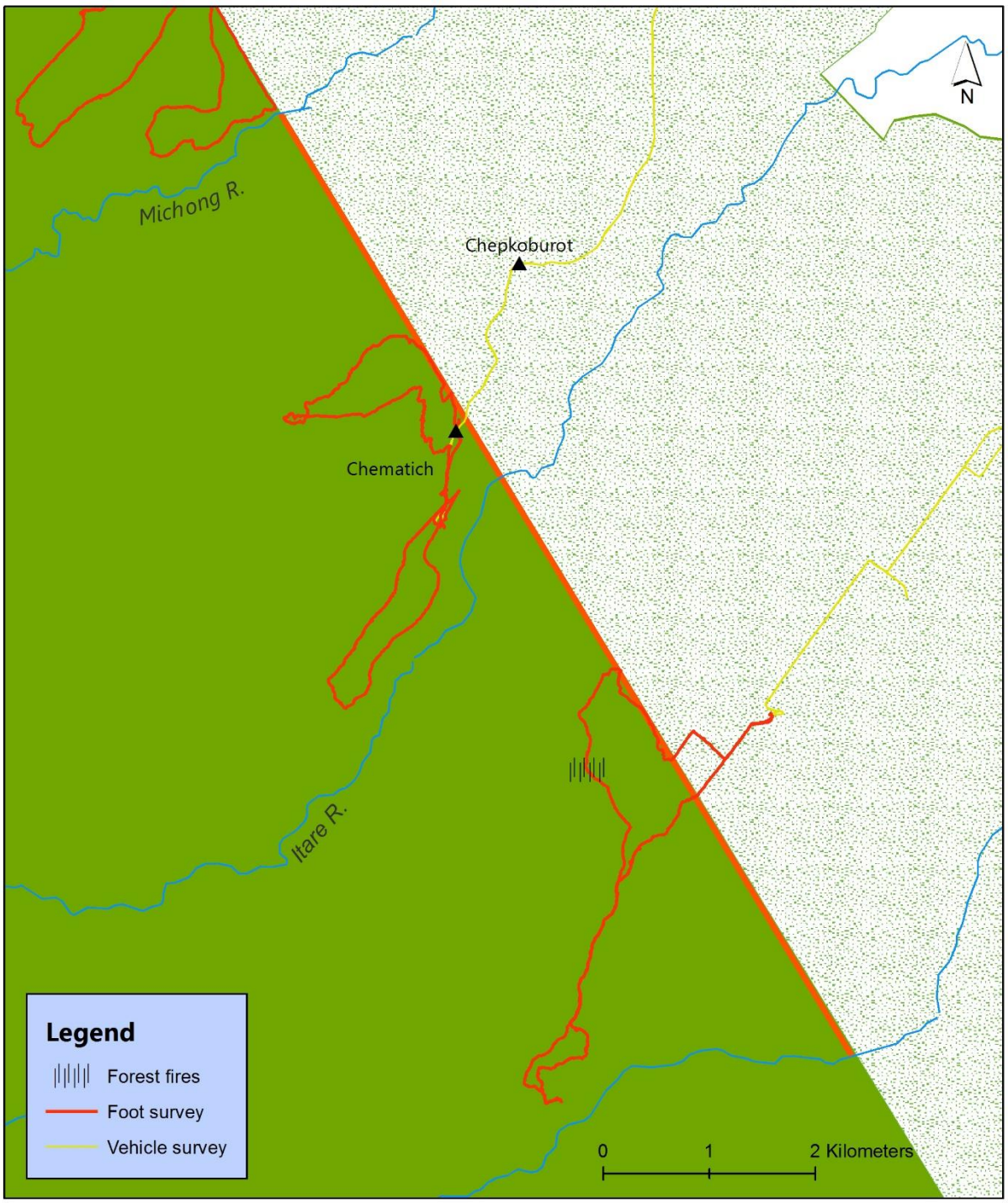


Figure 96. Area where a recent fire occurred in Section 2 of South Western Mau Forest Reserve. Burnt trees, and dead and standing trees, encountered during foot surveys, or viewed from distant vantage points, provide evidence of past fires over much of Section 2.

ELECTRIC FENCE

Placement: The extreme over-exploitation, both past and present, observed in Section 2 of SW Mau FR makes it clear that the only way the Government of Kenya will gain control of the area, and allow for the

forest to recover some of its conservation values, is through placement of a game-proof electric fence. It is, therefore, strongly recommended that an electric fence be constructed (Figure 97).

The game-proof electric fence should continue from the south end of Section 1 at the Michong River (S 00.42605; E 35.48928; 2,378 m asl) along the (straight) excision boundary of the SW Mau FR to the Kipsonoi River (S 00.50628; E 35.53793; 2,339 m asl) (Figure 97). There is no compelling reason for any part of the unexcised SW Mau FR to lie outside of the fence. The total length of the fence for Section 2 is *ca.* 10.3 km.

Compared to other sites in Kenya where a game-proof electric fence has been erected, the construction of the fence for Section 2 will be relatively easy. There are no rugged or steep sections.

The positive and negative impacts of a game-proof electric fence are summarized on pages 38 -41.

Access gates: All of the fence-line is close to heavily-used footpaths and roads that come from the local communities up to the fence-line. These offer many good sites for the establishment of access gates. Local communities should be consulted as concerns the exact placement of all gates.

We propose that four pedestrian access gates be placed along the electric fence of Section 2. Mean distance between gates is 2.3 km (range 1.7-2.9 km; Figure 97). Major considerations as to the number of gates for Section 2 are that (1) there are already a large numbers of private woodlots in the area (some of them very large), and (2) the vast majority of local people are currently meeting their wood needs from the excised region to the east of this fence-line.

Table 9. Proposed locations and type of access gates for the game-proof electric fence in Section 2 of the South Western Mau Forest Reserve (see Figure 97).

Gate	Type of gate	Coordinates	Altitude (m asl)
6	Pedestrian	S 00.430; E 35.492	2,450
7	Pedestrian	S 00.452; E 35.505	2,452
8	Pedestrian	S 00.471; E 35.517	2,447
9	Pedestrian	S 00.484; E 35.525	2,406

There are several old logging roads into Section 2, most of which are in poor condition. Since logging indigenous forest in Kenya is no longer legal, there is no need for vehicle access into Section 2.

These four gates will allow local people controlled access to the forest to remove, in a sustainable manner, those products that they most want (*e.g.*, grass, firewood, bamboo, honey, medicines). See the Itare Participatory Forest Management Plan (2013-2017) (IPFMP, 2012).

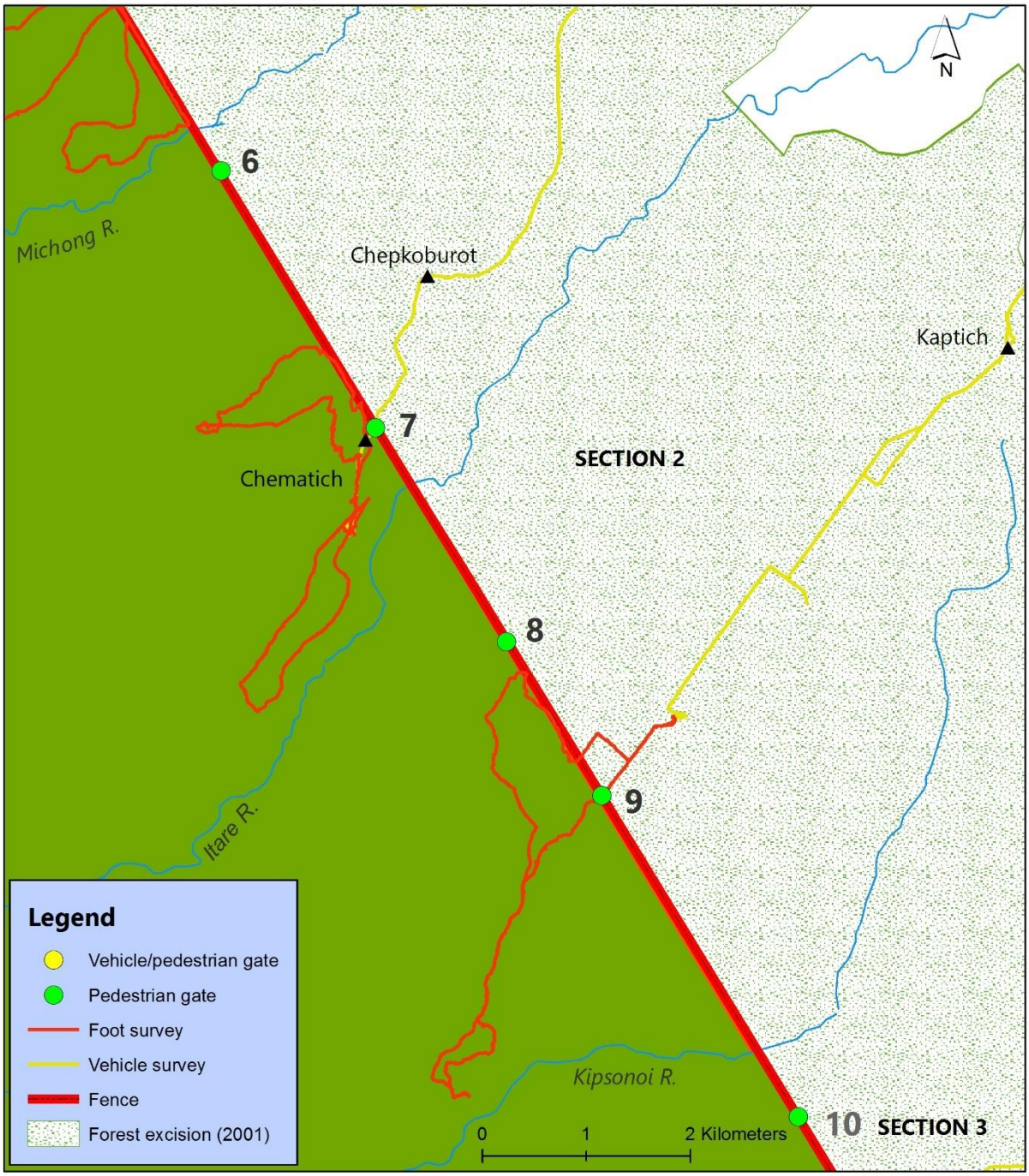


Figure 97. Location of the proposed comprehensive game-proof electric fence with wire mesh and four access gates for Section 2 of the South Western Mau Forest Reserve.

Situation outside the fence: Outside (east) of the proposed fence-line for Section 2, land that was excised in 2001 is today under dense human settlement, cropland, and pasture. Residents of this area have been there for, on average, *ca.* 17 years, and some for 42 years (since 1974). Although no significant areas of natural forest remain on the excised land, some of the excised land has a denser tree cover (indigenous and exotic tree species) than on the west side of the excision boundary. Most, if not all, residents have planted exotic trees on and around their plots, and some own tree plantations near the excision boundary.

Fence design: Given (1) that there is intensive agriculture on the edge of this section of the SW Mau FR, that (2) the forest here continues to be unsustainably exploited by people and is not recovering from past

encroachment, that (3) the large mammals responsible for most of the human-wildlife conflict reside within the Forest Reserve, and (4) that the terrain is not particularly challenging to construction of a fence, the fence all along Section 2 should be of the comprehensive game-proof electric fence with wire mesh design. This design will greatly reduce movement from the forest to the farmlands and settlements of the largest mammals (*e.g.*, elephant, buffalo, bushpig, leopard), as well as the larger burrowing mammals (*e.g.*, porcupine, hyaena, aardvark).

CONCLUSIONS

Section 2 is in a slightly better state then is Section 1, with some areas of degraded natural forest within 2.7 km from the excision boundary. Overall, however, the SW Mau FR is badly degraded, continues to be used unsustainably, and under great threat. The placement of a game-proof electric fence through Section 2 is strongly supported by the heads of households who live within 1 km of the SW Mau FR excision boundary. An electric fence is also supported by local officials and leaders. This electric fence is expected to (1) nearly eliminate human-wildlife conflict in the area; (2) allow for recovery of this most valuable of Kenya's natural assets; (3) help maximize the benefits of the forest to the local people and to the nation; and (4) ensure the long-term survival of this forest and its conservation values.

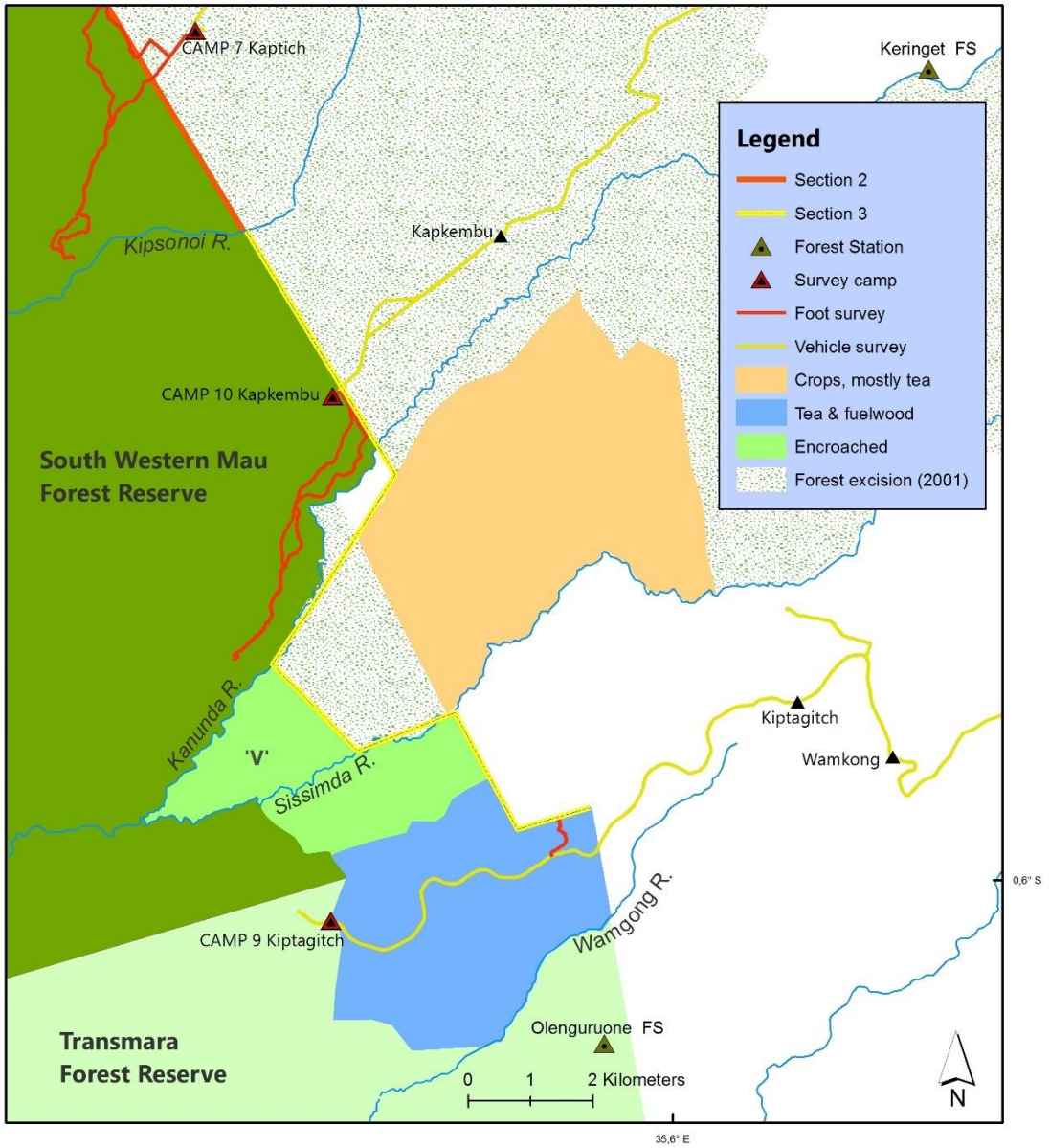
See pages 159 - 160 for additional conclusions that apply to Section 2.

Figure 98. Camp 7, Kaptich, South Western Mau Forest Reserve.

RESULTS SECTION 3: KIPSONOI RIVER TO TRANSMARA FOREST RESERVE

BACKGROUND

Location: Section 3 (Figures 99 & 100) begins at the Kipsonoi River (S 00.50628; E 35.53793; 2,339 m asl) and runs southeast along the SW Mau FR excision boundary northeast corner of Transmara Forest Reserve (S 00.58994; E 35.58806; 2,421 m asl).



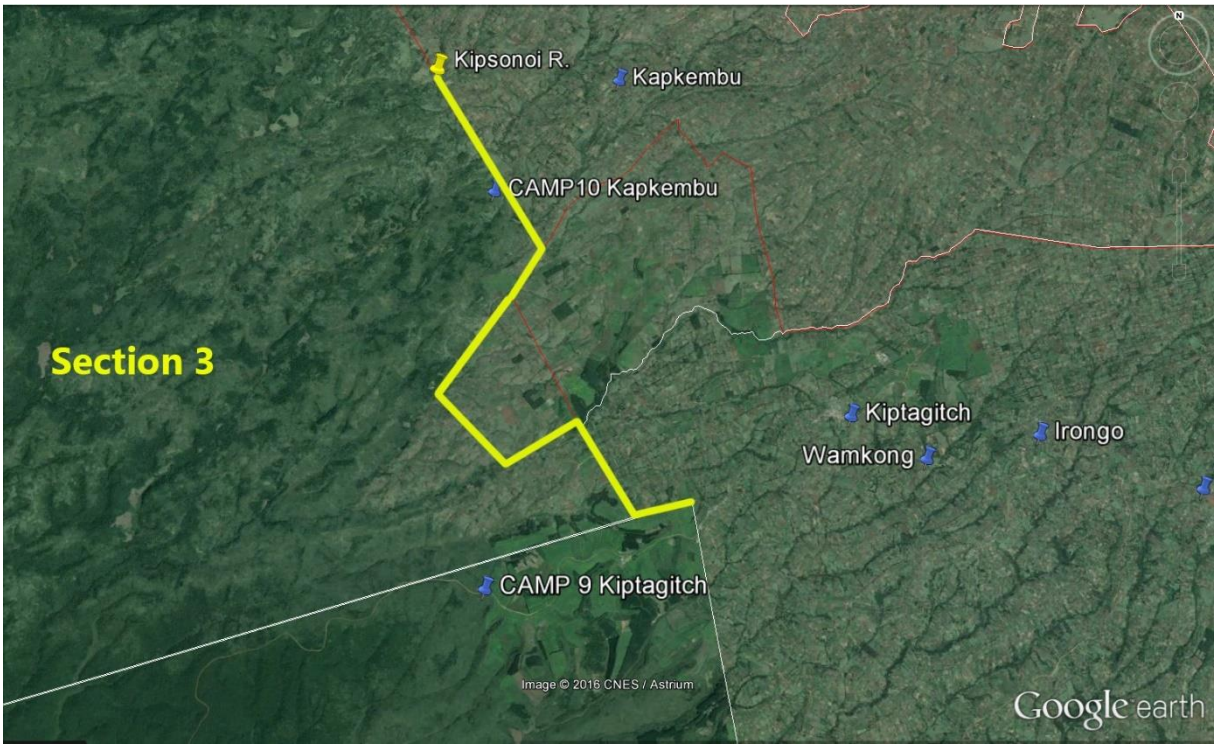


Figure 100. Location of Section 3 (yellow line) in South Western Mau Forest Reserve on a Google Earth map. The yellow line is the South Western Mau Forest Reserve 2001 excision boundary. The area to the east is heavily settled and under intensive agriculture. The area to the west, within the Forest Reserve, is degraded montane forest, encroached land, and pasture. The area to the south of the east-west white line is the Transmara Forest Reserve. There are large tea estates and a big tea factory here in the Kiptagitch area.

Length: Section 3 has a length of *ca.* 14.1 km (measured using ArcGIS).

Purpose: Evaluate Section 3 for placement of a game-proof wildlife barrier. This barrier is expected to (1) stop further encroachment by people and tea companies; (2) reduce the level of human-wildlife conflict in the area; (3) protect a large and vital watershed; (4) reduce degradation, fragmentation, and destruction of SW Mau FR; and (5) allow for the long-term sustainable use of forest products.

This study establishes socio-economic, human-wildlife conflict, forest exploitation, and environmental baselines against which to assess change.

SOCIO-ECONOMIC ENVIRONMENT

Human population and land use:

Number of people interviewed:

- Heads of households: 69
- Officials and leaders: 6

Head of household interviewee profile:

- Mean duration on farm: 15.8 years (range 1-37)
- Mean number of people in household: 6.8 people (range 1-16)
- Mean distance of farm from excision boundary: 263 m (range 2-1000)
- Mean size of farm: 3.5 acres (range 0.5-10.0) (Figure 101)
- Three main crops:
  - maize (n=60)
  - potatoes (n=56)
  - beans (n=29)
- Mean number of livestock per farm: 9.8 head (range 1-57) (Figure 101)
- The human population of Section 3 is high with intense tea farming in the southern half of the section. Farm plots, commercial tea plantations, a Nyayo Tea Zone, and a large tea factory are within the SW Mau FR, forest excisions, and in the 'Proposed settlement' areas.

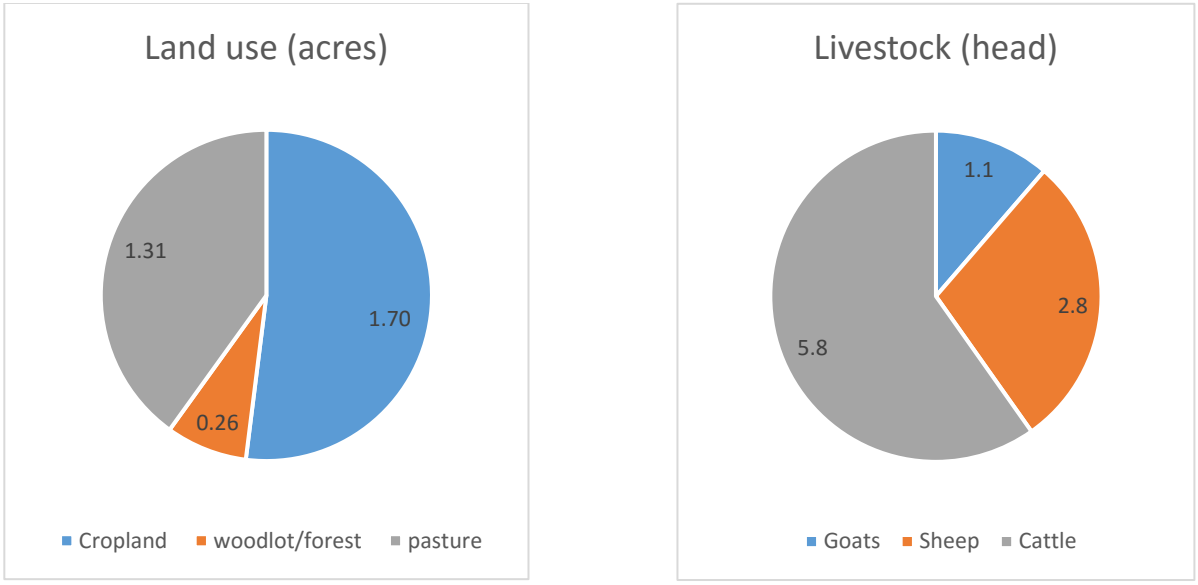


Figure 101. Main types of land-use and numbers of livestock on the average farm in Section 3 of South Western Mau Forest Reserve according to the heads of households (n=69).

HUMAN-WILDLIFE CONFLICT

Damage by wildlife to crops, livestock and infrastructure (*e.g.*, fences, buildings) is a main concern of heads of households (n=69). Officials and leaders (n=6) disagreed with this and rated these types of damage as 'little' or 'none' (Figure 102). During the barazza, leaders noted that there is no human-wildlife conflict in Section 3 as the Ogiek in this region are used to living with wildlife.

Crop damage:

- Heads of households: 57% said 'a lot'
- Officials and leaders: 0% said 'a lot'

Livestock loss:

- Heads of households: 51% said 'a lot'
- Officials and leaders: 0% said 'a lot'

"With a fence my crops will not be destroyed." Robert Rono

Damage to infrastructure:

- Heads of households: 57% said 'a lot'
- Officials and leaders: 0% said 'a lot'

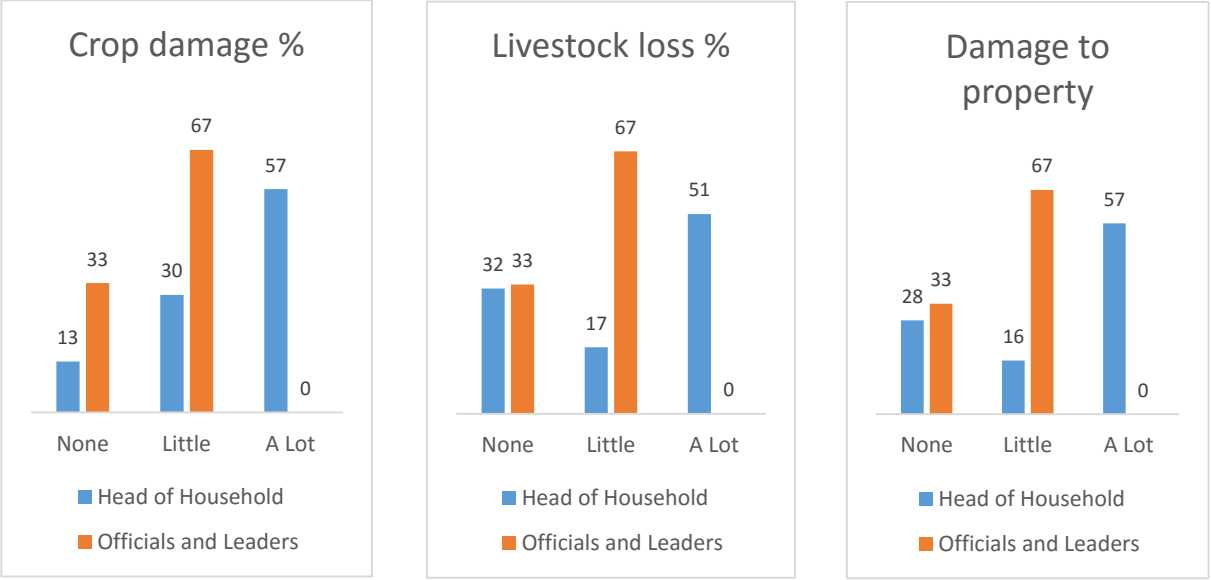


Figure 102. Crop damage, livestock loss, and damage to infrastructure by wildlife in Section 3 of South Western Mau Forest Reserve according to the heads of households (n=69), and officials and leaders (n=6).

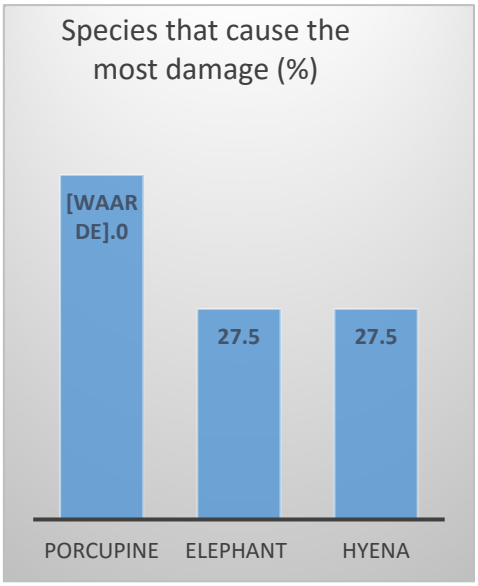


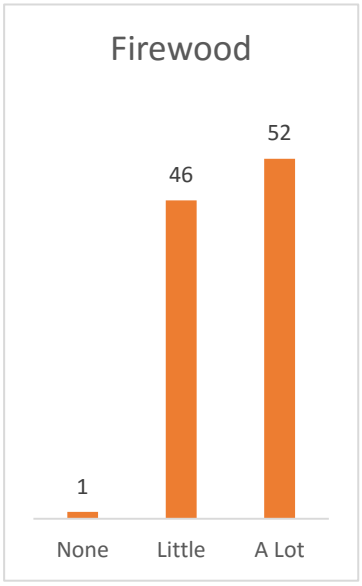
Figure 103. Species of wildlife which, according to the heads of households (n=40), cause the most damage in Section 3 of South Western Mau Forest Reserve. The number at the top of each bar represents the

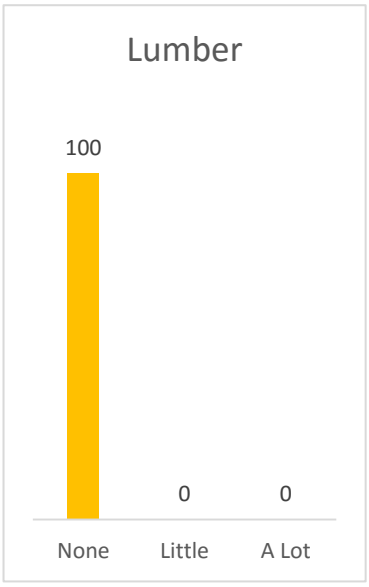
The wild animal species which cause the most damage in Section 3, according to the heads of households, are crested porcupine, elephant, and hyaena (Figure 103).

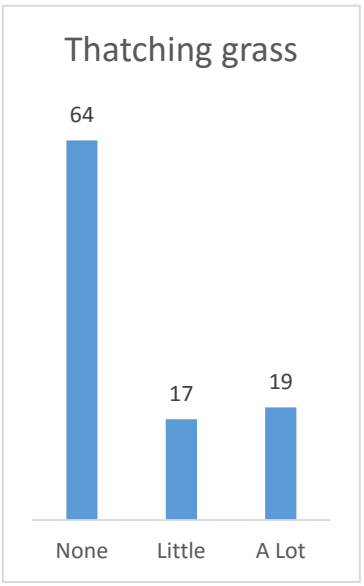
To stop wildlife from inflicting damage, interviewees (n=69) said that they use noise (80%), fire (57%), and dogs (17%). Only one interviewee said she reports cases of human-wildlife conflict to KWS or KFS. Officials and leaders at the barazza claim they have no conflicts with wildlife as they kindly request the animals (particularly elephants) to move away. They use dogs to scare off the smaller species.

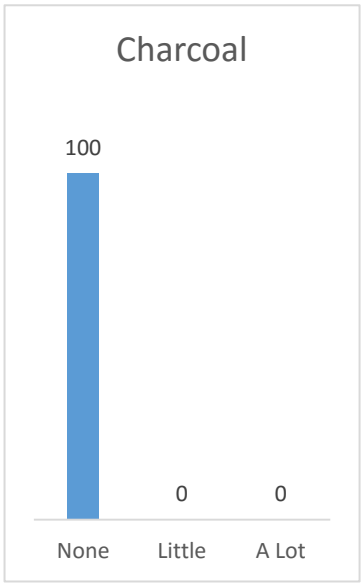
UTILIZATION OF THE FOREST RESERVE

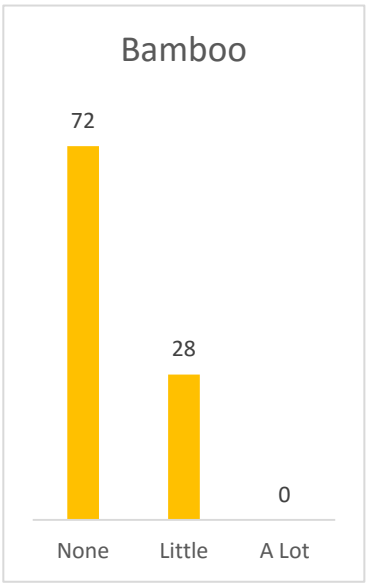
All households (n=69) in Section 3 use the SW Mau FR to some extent, and almost all use the Forest Reserve 'a lot'. They use the SW Mau FR 'a lot' for grazing (94%), medicines (88%), firewood (80%), and honey (59%; Figure 105). Heads of households claim that they do not use the SW Mau FR for charcoal, lumber, or meat. No person said they get water from the SW Mau FR. These results suggest that there is ample charcoal, lumber, meat, and water outside the SW Mau FR. The officials and leaders who attended the barazza claim that forest destruction is mainly done by non-residents.

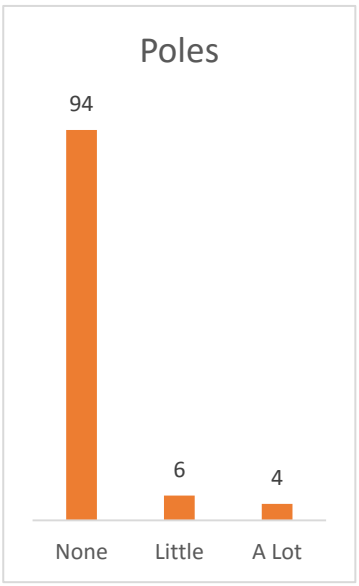

Firewood
1
46
52
None
Little
A Lot

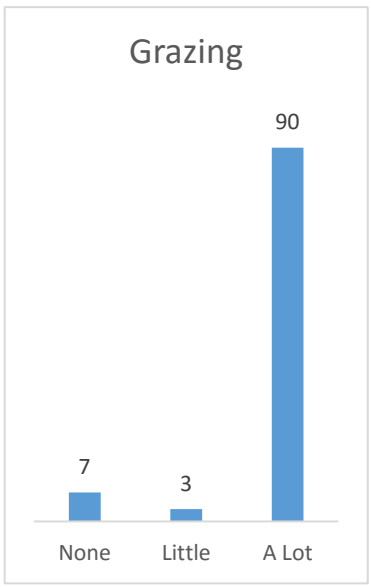

Lumber
100
0
0
None
Little
A Lot


Thatching grass
64
17
19
None
Little
A Lot


Charcoal
100
0
0
None
Little
A Lot


Bamboo
72
28
0
None
Little
A Lot


Poles
94
6
4
None
Little
A Lot


Grazing
7
3
90
None
Little
A Lot

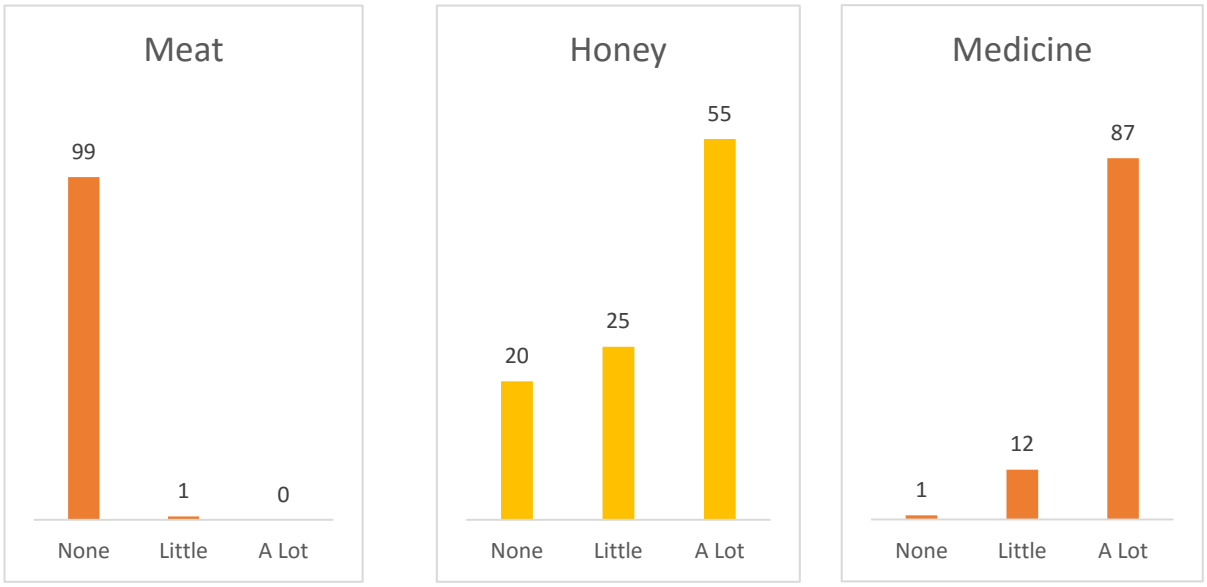


Figure 105. Use of 10 forest products by residents in Section 3 of South Western Mau Forest Reserve according to heads of households (n=69). As concerns the amount of use, the choices were 'none', 'little' or 'a lot'. The bars in these graphs represent percentages.

ATTITUDES TOWARDS A BARRIER

Ninety-six percent of the heads of households (n=69) said that they would be 'happy' if an electric fence were constructed, while 4% said they are 'unhappy' with the concept. While the respondents understood that the fence would greatly limit the level of illegal exploitation of the SW Mau FR, they were positive about the potential reduction in damage by wildlife to their crops, livestock, and infrastructure. Sixty-seven percent of officials and leaders (n=6) said they would be 'happy' with an electric fence, while 33% said they would be 'unhappy' with a fence.

During the barazza it became clear that there is a long-term county boundary dispute in court. The majority of the leaders and residents who attended the barazza, including members of the Ogiek tribe, said they were unsupportive of a fence as long as the boundary dispute in Section 3 was not resolved.

The reasons given for local support of an electric fence included reduced damage by wildlife, reduced poaching of wild animals, less movement of people into the Forest Reserve, and less forest destruction, particularly as a result of charcoal-making. Interviewees also mentioned the job opportunities the construction and maintenance of a fence would bring. Almost all interviewees (97%) believed there will be enough people within the community willing and able to help with construction and maintenance of the fence.

Figure 106. Dr. Kipkiru Langat (ISLA) and Mr. Boniface Mulwa (KFS) with officials, leaders, and elders at the Kapkembu barazza (21 January 2016) in Section 3 of the South Western Mau Forest Reserve.

When heads of households (n=69) were asked, "Do you prefer a Nyayo Tea Zone or an electric fence as a barrier for the South Western Mau Forest Reserve?", 93% said "fence", 4% said "Tea Zone", and 3% said "no opinion". On the contrary, 34% of the officials and leaders (n=6) said they prefer an electric fence and 66% preferred a Nyayo Tea Zone. A Nyayo Tea Zone will be a more suitable barrier, they believe, as they expect this will create jobs and generate more cess cash for the Nakuru County Government. The attendants did not comment on the benefits of forest conservation. Yet, all attendants agreed forest conservation is important as their livestock depend on forest resources. To best way to preserve the Mau Forests Complex, they claim, is to put in a Nyayo Tea Zone as a barrier to stop illegal activities, to make forest roads, and to employ community members, especially elders.

All interviewees of the Head of Household Questionnaire and of the Officials and Leaders Questionnaire, as well as those people who attended the barazza, said forest conservation is important. They believed that the best way to protect the SW Mau FR from further degradation and destruction is through a combination of conservation education, a barrier, community participation, people working more closely with CFAs, additional forest rangers, improved permit system, increased patrols by forest rangers and community members, and planting trees. The leaders and officials at the barazza claim that forest destruction is done by non-residents. They believe that a Nyayo Tea Zone will help prevent those non-residents from going into the forest. One leader at the barazza claimed that an all-weather road into the forest will help chase poachers.

PHYSICAL ENVIRONMENT

Altitude: The altitudinal range along the SW Mau FR excision boundary is 2,300-2,455 m asl. Overall, the terrain is rather flat with gently sloping valleys where streams flow. Ten streams/rivers flow out of Section 3, including the Kipsonoi River.

Rainfall: Mean annual rainfall over Section 3 is *ca.* 1,300 mm (WRI, 2007).

Soil: The soil in Section 3 is described as "*well drained, extremely deep, dark reddish–brown, friable and flightly smeary clay, with an acid humic topsoil*" (Sombroek *et al.*, 1982).

Suitability of the terrain for an electric fence: The terrain along the entire proposed Section 3 barrier line is suitable for construction of an electric fence. Given that all of the boundary was once within an encroached area, few trees would need to be removed in order to clear the 7-10 m-wide strip required by an electric fence.

BIOLOGICAL ENVIRONMENT

Vegetation: Section 3 lies within the 'East African Montane Forest Ecoregion' (WWF, 2004). The montane forests that once occurred within 3 km west of the excision boundary has been degraded everywhere, particularly over the northern part of Section 3. Most of the area is now comprised of fragmented secondary forest, bush, short-grass glades, bamboo, and erosion gullies. While the forest here is less damaged than in Sections 1 and 2 (most noticeably the sites with stands of bamboo), this is the only section with agricultural encroachment.

The more common indigenous trees observed in Section 3 during this study are the colonizing, secondary forest, species *Hypericum revolutum, Macaranga kilimandascharica, Dodonaea augustifolia*, and *Nuxia congesta.*

Other indigenous tree species observed are P*odocarpus latifolius, Polyscias kikuyuensis*, *Elaeodendron buchananii, Tabernaemontana stapfiana, Hagenia abyssinica, Psychotria mahonii, Ficus* spp., *Cassipourea malosana, Croton macrostachyus,* and *Neoboutonia macrocalyx*.

Exotic trees species here are *Pinus sp.* and *Cupressus lusitanica.*

Other plants encountered here are *Rubus* sp., *Arundinaria alpina, Vernonia auriculifern, Pteridium aquilinum, Solanum* spp., and *Rubus sp.*

As all along the excision boundary, the vast majority of trees grown outside the excision boundary are exotics.

Table 10. Details of sample points in Section 3 of the South Western Mau Forest Reserve at which vegetation and disturbance were described (Figure 109).

Number	Date	Time	Latitude	Longitude	Altitude m asl	Vegetation	Disturbance
32	20 January	12:58	S00.53610	E35.55543	2400	Natural forest with patches of bamboo. Vernonia, bracken, *Macaranga, Dodonaea, Tabernaemontana*, Podo, *Nuxia, Neoboutonia, Hypericum, Psychotria, Polysius, Cassipourea*, and a few *Hygenia*, figs, cypress, and pine.	Pasture and paths heavily used by livestock, and forest heavily used by people.
33	20 January	15:16	S00.55772	E35.54317	2418	Former shamba. Now bushland with bamboo and *Hypericum*.	Heavily used pasture and degradation bush.

Figure 107. 360 degrees photograph of sample point 33 (Table 10, Figure 109).

Figure 108. 360 degrees photograph of sample point 34 (Table 10, Figure 109).

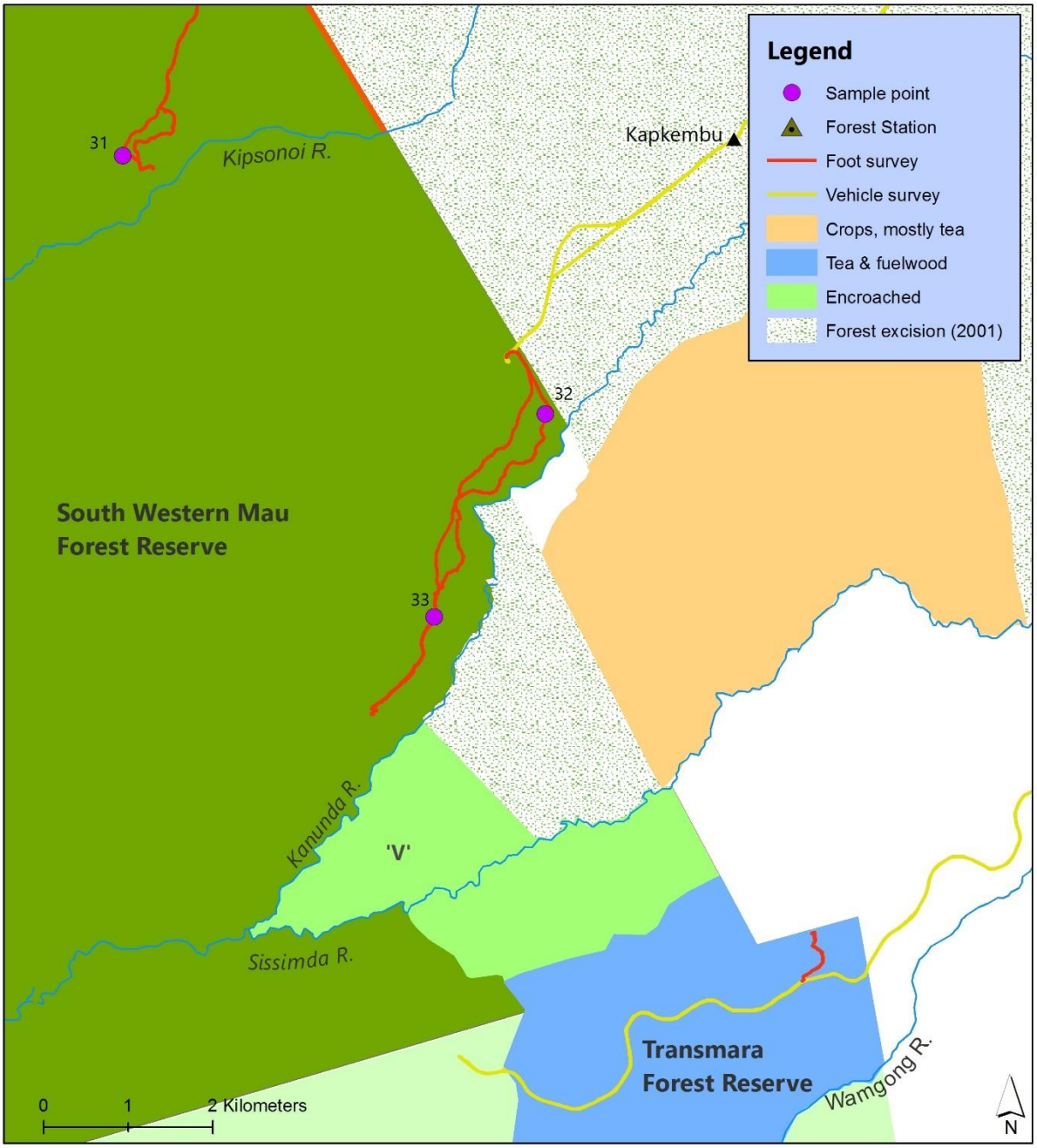


Figure 109. Locations of sample points in Section 3 of South Western Mau Forest Reserve at which vegetation and habitat disturbance were described (Table 10).

Exotic tree plantations: No exotic tree plantations were encountered during foot surveys in Section 3. Fuelwood (mainly eucalyptus) plantations are scattered along the streams and rivers of the tea estates.

There is no natural forest outside of Section 3. Besides tea, residents to the east of the SW Mau FR excision boundary have planted a substantial number of trees for fuel wood and poles. There are large numbers of exotic trees west of the SW Mau excision line; eucalyptus, pine, cypress, black wattle, grevillea, and others. Most of these were planted near homesteads from which encroachers were removed in 2009.

The 'Proposed settlement' areas (Figure 6) are mainly occupied by large commercial tea plantations. 'Proposed settlement' appears to me a misnomer. To the south there are contiguous large commercial tea plantations and a big tea factory located on an 'unformalized excision' of the Transmara Forest Reserve.

Diversity of medium and large mammals: Mammals which this study confirmed as present in Section 3, within 2.5 km to the west of the SW Mau FR excision boundary, are elephant, aardvark, guereza monkey, Stuhlmann's blue monkey, southern tree hyrax, and spotted hyaena (Figure 110).

Only one old sign of elephant was found in Section 3. Nonetheless, interviewees claim that elephants cause damage in the area. A Forest Ranger said that *ca*. 50 elephants were seen in this area April 2015. Officials at KWS in Kericho said that elephants come out of the SW Mau FR to raid crops during September-November.

Leopard and bushpig were not seen or heard in Section 3, but interviewees claimed that bushpigs damage their crops. We observed sites that appeared to have been dug-up by bushpigs.

Aardvark are common, based on the numerous aardvark holes encountered during foot surveys.

The following mammals are among those that are expected to occur in Section 3, but which were not confirmed present during this study: yellow-backed duiker, bushbuck, honey badger, African golden cat, potto, northern lesser galago, African civet, genet *Genetta* sp., palm civet, white-tailed mongoose, zorilla, hare *Lepus* sp., and jackal *Canis* sp.

Rangers at Chematich Forest Station claimed that bongo occur in Section 3. In fact, two bongo were said to have been encountered by a Ranger *ca*. 6 km from the SW Mau FR boundary during January 2016. Apparently absent from Section 3 are olive baboon, vervet monkey, giant forest hog, and lion.

Medium and large mammal densities are low. The officials and leaders who attended the barazza were not sure why densities were currently low. They speculated, however, that encroachment and the influx of people into the area chased the wildlife to other parts of the Mau Forests Complex. It was claimed that the Ogiek have always protected the wildlife and continue to do so. The Ogiek want to be identified as those who protect the wildlife in this part of the Mau (see Sang, 2001; Spruyt, 2011). There were suggestions that the large tea companies are causing damage to the ecosystem.

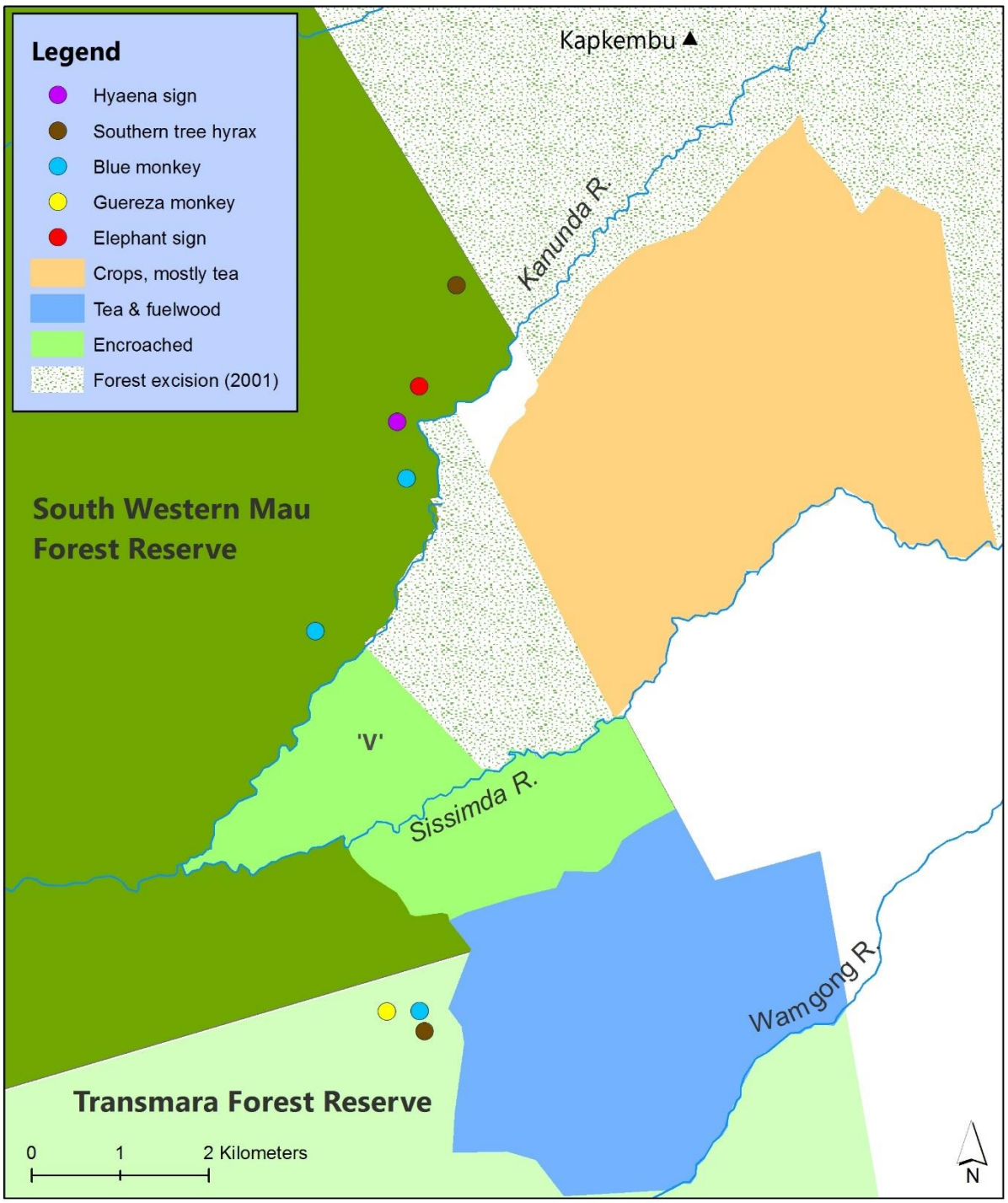


Figure 110. Records of medium and large mammals seen, heard and/or camera trapped in Section 3 of South Western Mau Forest Reserve and Transmarra Forest Reserve.

Bird diversity: Only 18 bird species were recorded in Section 3, but not as much time was spent searching for birds here as in Sections 1 and 2. Nonetheless, fewer bird species are expected here as this area is dominated by large stands of bamboo intermixed with scattered *Podocarpus latifolius* (some of them large) and a small number of other tree species. Tree diversity in Section 3 is low. The total number of bird species encountered during this survey in Sections 1, 2 and 3 was 76. All species

encountered were expected to occur. What was most striking concerning the birds of the region within 3 km to the west of the eviction boundary was the very low density of hornbills and parrots, and the absence of encounters with any species of woodpecker. All species of forest hornbills, parrots, and woodpeckers are dependent on tree holes for nesting. Their absence is likely due, in large part, to the paucity of large trees with nest holes. Hornbills are major dispersers of seeds of many species of forest tree. The absence of hornbills is likely a considerably hinderance to the regeneration of natural forest in the former encroached area.

THREATS

Encroachment, forest utilization, degradation, fragmentation, and loss in Section 3 is high and will certainly worsen given the lack of control of the taking of forest products and what is likely a rapidly growing human population in this area. Illegal and unsustainable exploitation of forest products was observed during all foot surveys. Damage to the forest is particularly extensive and excessive within 2 km of the edge of the SW May Forest excision boundary. This included logging, fire, wood collection, charcoal-making, and grazing/browsing by cattle and sheep. No undamaged, primary, forest remains. Most of the natural forest has been removed for 2 km from the (excision) boundary. Fragments of degraded natural forest are still present at some sites in Section 3. Outside these fragments, heavy browsing by livestock means that the seedlings of most tree species have little or no chance of surviving. The biggest threat to the regeneration of the montane forest in Section 3 is over-browsing by livestock.
During foot surveys, no forest rangers or CFA members were encountered on patrol.

Figure 111. In the distance is the largest (*ca*. 8.2 km²) encroached area in South Western Mau Forest Reserve. This encroached area, located in Section 3 and known as 'V', is comprised of pasture, crops (including tea), exotic trees, and settlement. See maps in Figure 99 and in SMCA (2016).

Encroachment: An area of *ca*. 8.2 km² is currently encroached (an area often referred to as 'V'). (Figure 99). The encroached area is covered with pasture, small plots of crops (including tea plantations), exotic trees (particularly cypress and eucalyptus), and human settlement.

Based on Figure 99, and the map in SMCA (2016), it appears that one or a few tea estates extend into the southeast corner of SW Mau FR while mostly in Transmara FR. Also see the map in SMCA (2016).

Besides the current encroached area, large areas of Section 3 were previously encroached, with the encroachers evicted in 2009. The evidence of their destruction is still obvious. These has been little, if any, recovery of the vegetation from the damage. Former farm plots, often demarcated by exotic trees, are now partly over-grown with bush or have become livestock pasture. Surprisingly, some large podocarpus trees and clumps of bamboo persist within some small areas of degraded natural forest.

Figure 112. At least three tea zones are adjacent to the montane forest at the southeast corner of the South Western Mau Forest Reserve. These extend into the Transmara Forest Reserve.

Figure 113. On the horizon is the Kipkongoro Internally Displaced People Camp. This camp is near the *ca*. 8.2 km² 'V' encroached area. This camp has *ca*. 700 people according to Kenya Forest Service rangers.

Section 3 had an Internally Displaced People (IDP) camps near KFS's Kapkembu Outpost (S00.53001; E35.55081, 2,451 m asl). This camp closed in 2013. A second IDP camp, Kipkongoro Camp near the V encroached area, is still active and has *ca*. 700 people according to KFS rangers

(Figures 113).

Charcoal: One active charcoal pile was located during foot surveys in Section 3 (Figure 114) but the smell of charcoal smoke was detected at a few other sites. Charcoal-making in Section 3 was not nearly are prevalent as in Section 1.

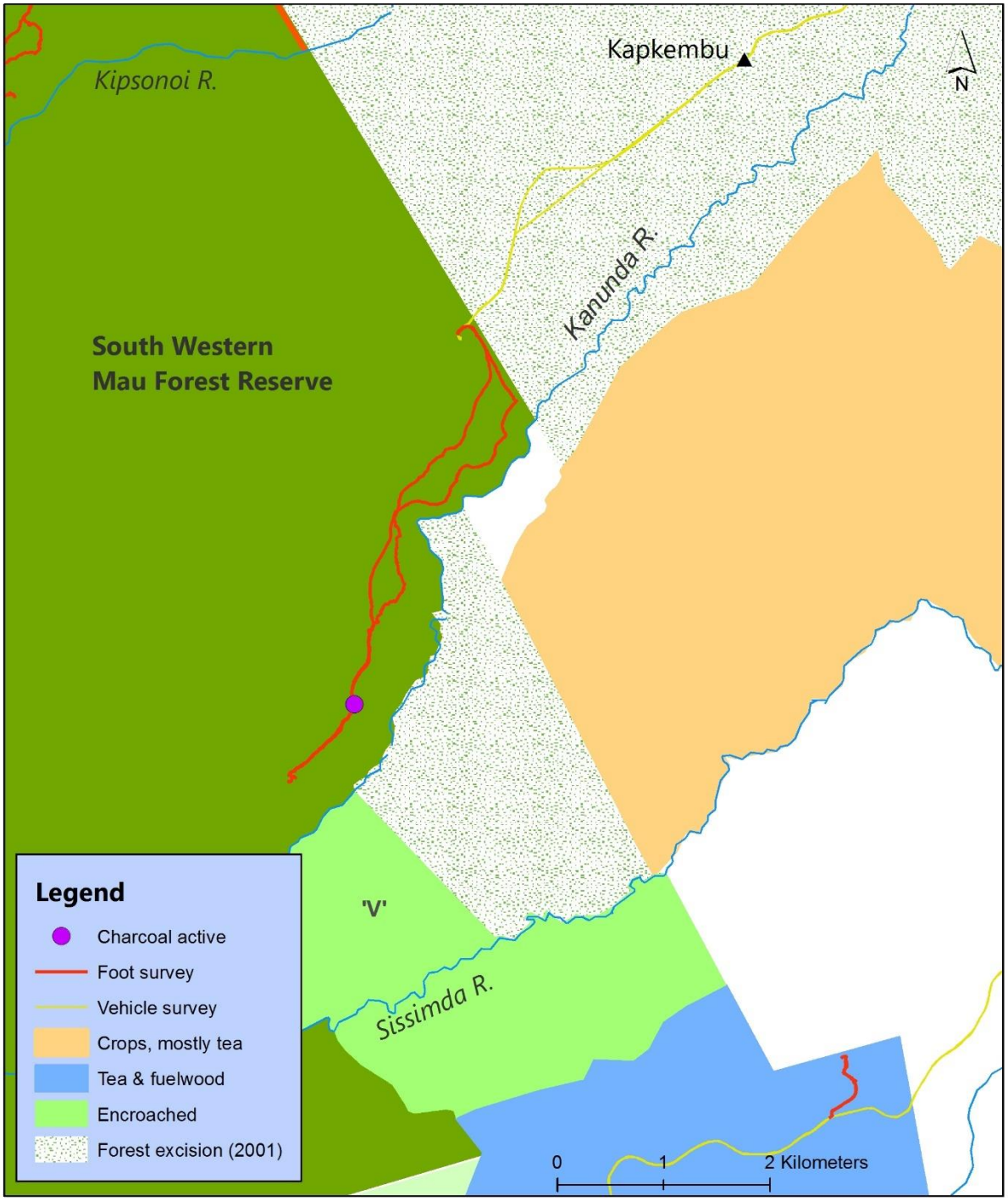


Figure 114. The one site where charcoal-making was observed during foot surveys in Section 3 of South Western Mau Forest Reserve. Several charcoal pits were found at this site.

Poaching: No animal traps were found in Section 3.

Wood removal: Firewood removal from Section 3 is extensive (excluding the *ca*. 8.2 km² encroached land), but not as prevalent as in Sections 1 and 2. Bamboo poles are cut for making fences and to provide support for mud-covered buildings.

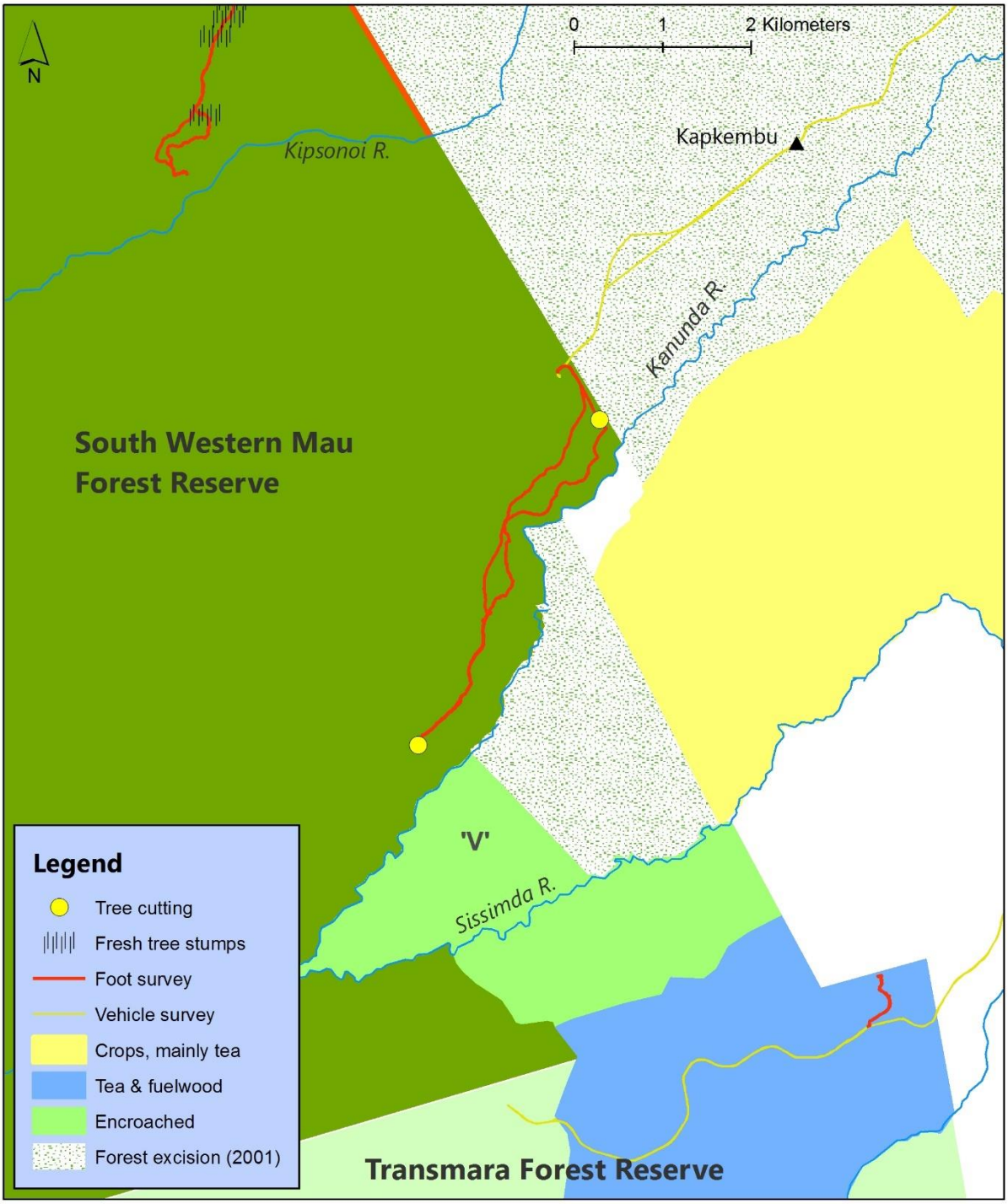


Figure 115. Sites where wood removal was observed during foot surveys in Section 3 of the South Western Mau Forest Reserve. As wood removal was common on the 2001 excision boundary, the encroached areas, and the area proposed for settlement, those records are not depicted on this map.

Table 11. Wood removal in Section 3 of the South Western Mau Forest Reserve.

Wood removal	Number of sites
Fresh-cut stumps	0
Wood piles	0
Debarking	0
Tree cutting	2
People with poles	0
People with firewood	0
Firewood piles	0

Livestock: Grazing and browsing by cattle and sheep in Section 3 is common and widespread. Heavily used, seriously degraded, livestock tracks are found throughout Section 3. Severe soil erosion and the low density, or lack, of tree seedlings and saplings of some indigenous species indicate both extreme over-grazing and over-browsing. Livestock were observed to 1.3 km into the SW Mau FR from the excision boundary. Aerial surveys, however, readily find livestock >12 km into the SW Mau FR from the excision boundary. In other words, livestock are present in the centre of the SW Mau FR. What has happened here is that the large area of the SW Mau FR that were encroached upon, settled, and converted to cropland, has now been converted to heavily grazed and browsed livestock pasture, bushland, and woodland. The intense over-browsing of the woody vegetation in Section 3 by livestock is both (1) preventing natural regeneration of the forest and (2) has led to the failure of schemes to plant indigenous trees.

Cattle and sheep were the most often encountered livestock in Section 3. No goats were observed within Section 3. Although heavily grazed and browed by livestock, Sections 3 is not as severely damaged by livestock as are Sections 1 and 2.

Livestock are typically left, unattended, in the SW Mau FR from early morning to late afternoon. According to KFS rangers, all people within the Reserve have grazing permits. We, however, never observed our ranger guides asking herders for grazing permits. Of the many activities occurring in Section 3, livestock grazing and browsing is the most damaging to the forest.

Figure 116. Grazing and browsing by livestock in Section 3 of South Western Mau Forest Reserve is common, widespread, and preventing regeneration of the montane forest.

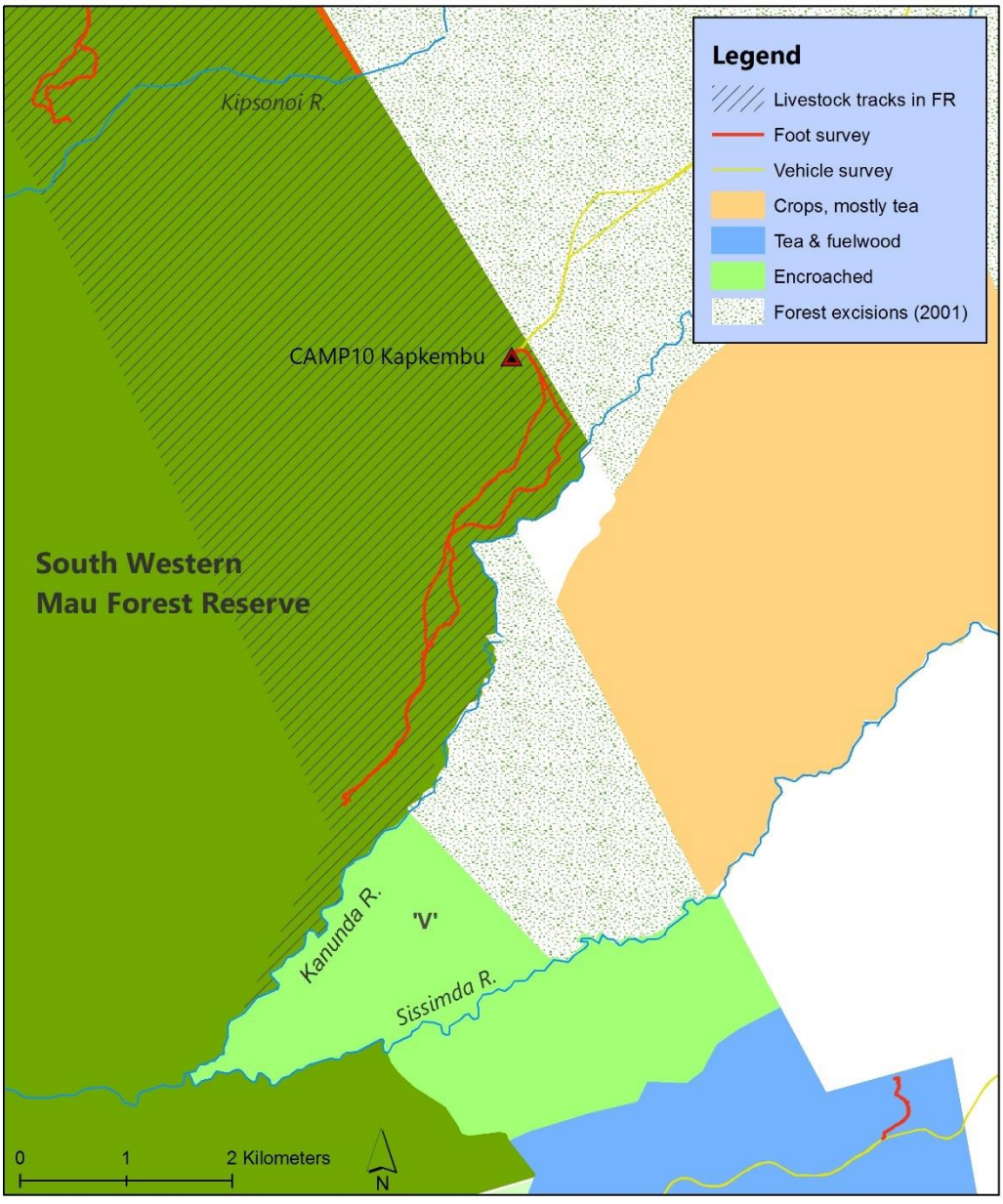


Figure 117. Are used by livestock in Section 3 of South Western Mau Forest Reserve.

Fire: An area >40 ha (S 00.54457; E 35.54642; 2,390 m asl) that was burnt in February 2015 was encountered during a foot survey. Local leaders claim that fires in Section 3 are most often started by honey collectors, and that fire is one of the major threats to the forest here.

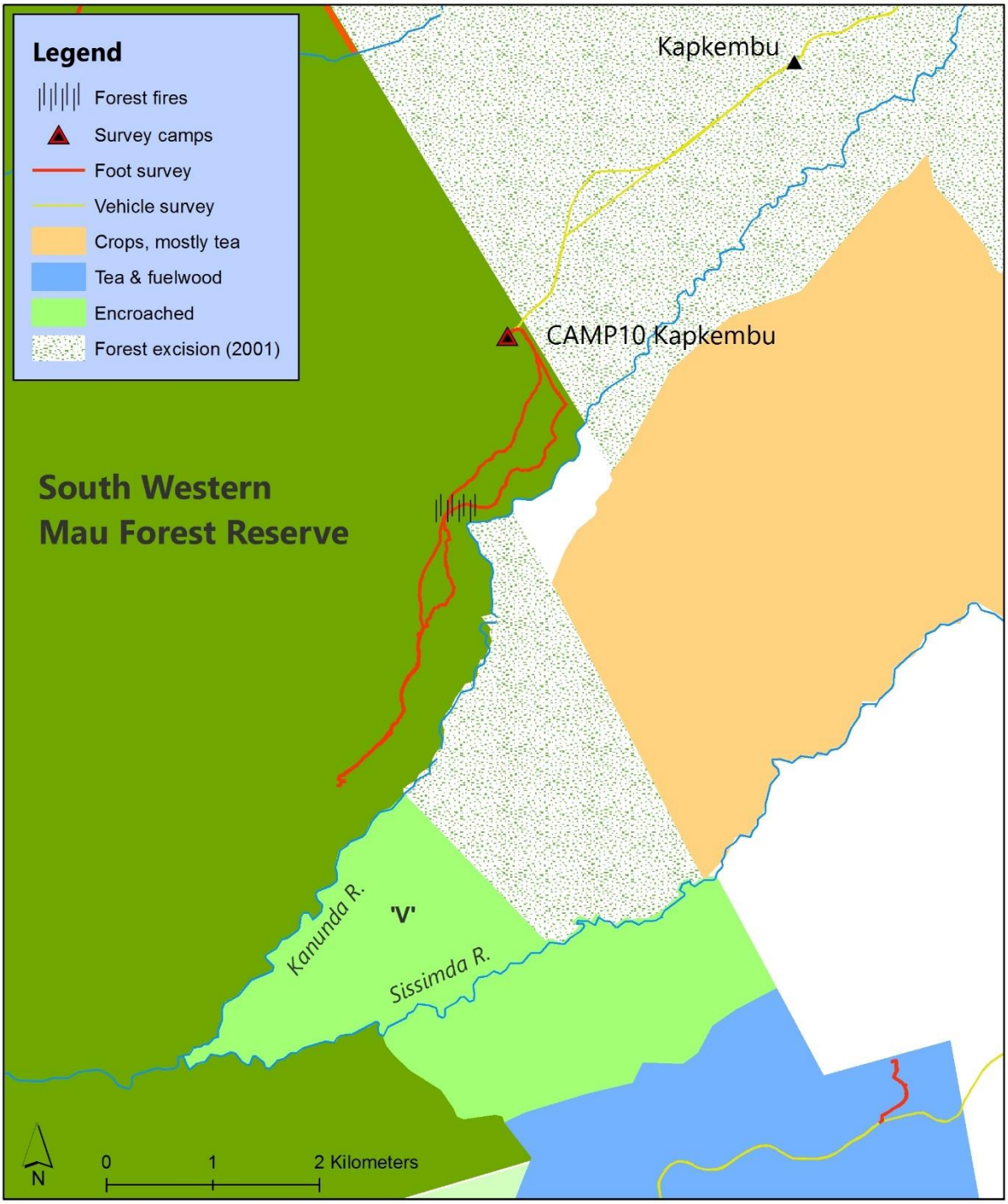


Figure 118. Area where a recent fire occurred in Section 3 of South Western Mau Forest Reserve. Burnt trees, and dead and standing trees, encountered during foot surveys, or viewed from distant vantage points, provide evidence of past fires over much of Section 3.

ELECTRIC FENCE

Placement: The long-term encroachment and extreme over-exploitation, both past and present, observed in Section 3 of SW Mau FR makes it clear that the only way the Government of Kenya will gain control of the area, stop further encroachment, and allow for the forest to recover some of its conservation values, is through placement of a game-proof electric fence. It is, therefore, strongly recommended that an electric fence be constructed (Figure 119).

The game-proof electric fence in Section 3 should begin at the south end of Section 2 at the Kipsonoi River (S 00.50628; E 35.53793; 2,339 m asl) and continue to follow the SW Mau FR excision boundary to its south end at S 00.59304; E 35.57728; 2437 m asl; Figure 119). This is also where the excision boundary meets the Transmara FR. For the long-term good of Kenya and its people, this report strongly recommends that all encroachers in Section 3 be evicted. There is no compelling reason for any part of the unexcised SW Mau FR to lie outside of the electric fence. The total length of the fence for Section 3 is *ca.* 14.5 km. The alternative fence is *ca.* 16.0 km.

Compared to other sites in Kenya where a game-proof electric fence has been erected, the construction of the fence for Section 3 will be relatively easy. There are no rugged or steep sections.

The positive and negative impacts of a game-proof electric fence are summarized on pages 38 - 41.

Access gates: All of the fence-line is close to heavily-used footpaths, tea plantations and roads that come from the local communities up to the fence-line. These offer many good sites for the establishment of access gates. Local communities should be consulted as concerns the exact placement of all gates.

We propose that four pedestrian access gates and one pedestrian/vehicle gate be placed along the proposed electric fence of Section 3. Mean distance between gates is 3.1 km (range 2.2-3.9 km; Figure 119). Major considerations as to the number of gates for Section 3 are that (1) there are already a large numbers of private woodlots in the area (some of them very large), and (2) the vast majority of local people are currently meeting their wood needs from the excised region to the east of this fence-line.

Table 12. Proposed locations and type of access gates for the proposed game-proof electric fence in Section 3 of the South Western Mau Forest Reserve (see Figure 119).

Gate	Type of gate	Coordinates	Altitude (m asl)
10	Pedestrian	S 00.512; E 35.541	2,450
11	Pedestrian/vehicle	S 00.529; E 35.552	2,443
12	Pedestrian	S 00.556; E 35.547	2,330
13	Pedestrian	S 00.573; E 35.546	2,394
14	Pedestrian	S 00.581; E 35.571	2,412

There are several old logging roads into Section 3, all of which are in poor condition. Since logging indigenous forest in Kenya is no longer legal, there is no need for vehicle access to most parts of Section 3. Gate 11 is a pedestrian/vehicle accesses gate for the road that leads to a planned water

reservoir and pipeline to Bomet town. If these plans do not materialize, then this should be a pedestrian only access gate as there is no other good reason for vehicles to enter the Forest Reserve here. These five gates will allow local people controlled access to the forest to remove, in a sustainable manner, those products that they most want (*e.g.*, grass, firewood, bamboo, honey, medicines).

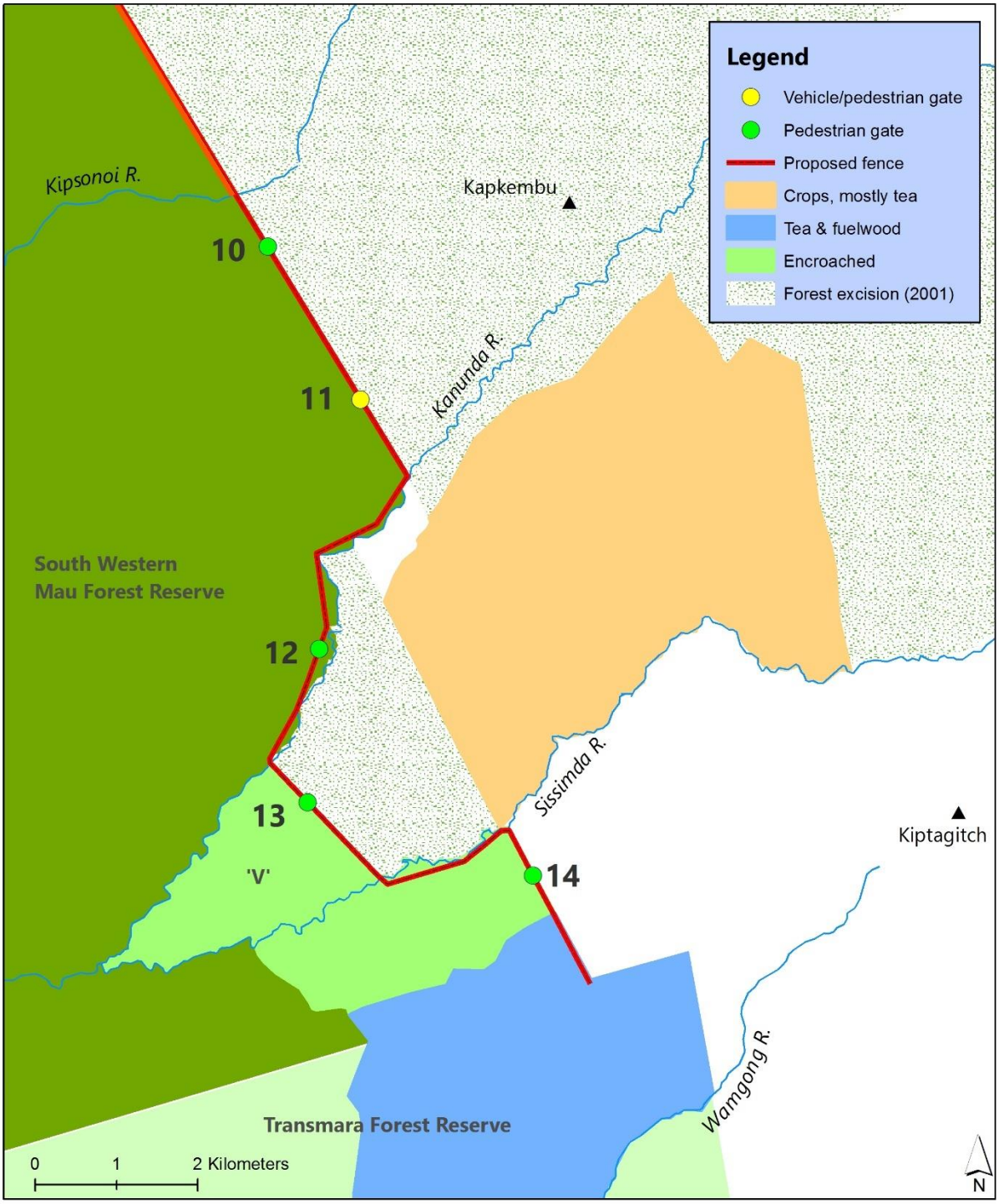


Figure 119. Location of the proposed comprehensive game-proof electric fence with wire mesh and five access gates for Section 3 of the South Western Mau Forest Reserve. Blue depicts the location of the 'unformalized excision' of the Transmara Forest Reserve. This is an area of large tea estables, exotic tree plantations, and a big tea factory that lies on the south border of the 'V' encroached area. The tan area is referred to as the 'proposed settlement area', but is now covered with crops, mostly tea. This is another 'unformalized excision' area.

Situation outside the fence: Outside (east and south) of the proposed fence-line/excision boundary for Section 3, the land is under dense human settlement, tea plantation, cropland, and pasture. Residents of this area have been there for, on average, 16 years, and some for 37 years (since 1979). Although no significant areas of natural forest remain, some of the land has a denser tree cover (indigenous and exotic tree species) than is present on the west side of the excision boundary. Most, if not all, residents have planted exotic trees on and around their plots, and some own tree plantations near the excision boundary.

Large tea estates (including the Nyayo Tea Zone) and private tea plantations are found within the encroached areas, within the excised areas, within the 'proposed settlement' areas, and outside the Forest Reserve, as well as within the adjacent unformalized excision in Transmara Forest Reserve.

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Figure 120. Large tea estates, private tea plantations, and fuelwood plantationsare within the encroached area, within the 2001 excised area, and within the 'proposed settlement' area, all of which lie within the gazetted South Western Mau Forest Reserve or in the 'unformalized excision' in the Transmara Forest Reserve. The large tea factory in the distance is within the unformalized exision of the Transmara Forest Reserve.

Fence design: Given (1) that there is intensive agriculture on the edge of this section of the SW Mau FR, that (2) the forest here continues to be unsustainably exploited by people and is not recovering from past encroachment, that (3) the large mammals responsible for most of the human-wildlife conflict reside within the Forest Reserve, and (4) that the terrain is not particularly challenging to construction of a fence, the fence all along Section 3 should be of the comprehensive game-proof electric fence with wire mesh design. This design will greatly reduce movement from the forest to the farmlands and settlements of the largest mammals (*e.g.*, elephant, buffalo, bushpig, leopard), as well as the larger burrowing mammals (*e.g.*, porcupine, hyaena, aardvark).

CONCLUSIONS

The biggest threats for Section 3 are the encroachment by people and tea companies, together with over-grazing and over-browsing by livestock. The natural forest of Section 3 is in a slightly better state then is Section 1 and 2. The former encroached area is badly degraded, continues to be used unsustainably, and remains under great threat. The placement of a game-proof electric fence through Section 3 is supported by 96% of those heads of households who live within 1 km of the SW Mau FR excision boundary and by 67% of the officials and leaders. This electric fence is expected to (1) stop further encroachment; (2) nearly eliminate human-wildlife conflict in the area; (3) allow for recovery of this most valuable of Kenya's natural assets; (4) help maximize the benefits of the forest to the local people and to the nation; and (5) ensure the long-term survival of this forest and its conservation values. Although 93% of the heads of household prefer a fence over a tea zone, only 34% of the officials and leaders do. During the barazza it became clear that there is a long-term dispute concerning the county boundary in the Section 3 area.

See pages 159 – 160 for additional conclusions that apply to Section 3.

Figure 121. Tea pluckers on a tea estate in the unformalized excision of the Transmara Forest Reserve off the southeast corner of the South Western Mau Forest Reserve.

CONCLUSIONS

- The W Mau FR and SW Mau FR have been greatly reduced in size, degraded, and fragmented over the past 80 years.
- The corridor of natural forest that connects the main block of the W Mau FR and SW Mau FR is narrow (*ca*. 1.8 km wide), degraded, and threatened. The loss of this vital corridor would result in the further fragmention of the Mau Forests Complex and greatly affect the long-term viability of many species in this region.
- Exploitation of the W Mau FR and SW Mau FR continues to be high and unstainable for most forest products, particularly for wood products. The exceptions appear to be honey, bamboo, and butterflies.
- Heavy grazing and browsing by livestock is preventing the recovery of forest in the former encroached area. This has led to large areas of heavily eroded soil, failure of the natural forest to regenerate, and failure of indigenous tree planting projects.
- The biodiversity of the former encroached area is low, as is the abundance of larger mammals and birds. Buffalo, bongo, giant forest hog, and hornbills are now absent, or nearly so.
- There are no effective controls on exploitation of any forest products. No KFS or KWS rangers were encountered on patrol. KFS Rangers were not seen asking forest users to exhibit their permits for livestock grazing or to take forest products.
- Exotic tree plantations within W Mau FR have not been replanted. The continued existence of these plantations threatens the viability of what little remains of the natural corridor between the main block of the W Mau FR and the SW Mau FR.
- No current encroachment was observed over most of the survey area. There is, however, an active encroached area of about 8.2 km² at the southern end of the survey area.
- Forest-adjacent farms (mean size=3.8 acres) appear to be highly productive, with a mix of cropland, pasture, and woodlot. Mean number of livestock is 12.4.
- Within 2 km of the east boundary of the W Mau FR and of the SW Mau FR 2001 excision boundary, there are more trees outside the boundary than inside. There are fewer trees within the eviction area now than at the time of the eviction.

- Use of the eviction area has changed from one where crops were intensively grown by encroachers to one used by forest-adjacent dwellers for intensive livestock grazing and browsing.

- More Community Forest Associations (CFAs) are needed. Those that exist are weak.

- It appears that this is a region of very rapid human population growth. The population near the forest is likely to double in <25 years.

- According to forest-adjacent dwellers, their main use of the W Mau FR and SW Mau FR is for grazing, firewood, medicines, and honey.

- Forest-adjacent dwellers badly need jobs. Rate of recovery of the conservation values of the W Mau FR and SW Mau FR needs to be enhanced. Improved honey and bamboo production, as well as butterfly farming, have created jobs and served as effective forest conservation activities elsewhere in Kenya.

- According to forest-adjacent dwellers, the level of conflict with wildlife is high. The main problem animals are elephants, porcupines, and hyaenas.

- Given the current unsustainable use of W Mau FR and SW Mau FR, and the high level of human-wildlife conflict, a barrier is required to both help control the taking of forests products and to greatly reduce human-wildlife conflict.

- Almost all (98%) forest-adjacent dwellers said that they would be "happy" with an electric fence game barrier. Ninety-five percent said that they prefer an electric fence game barrier to a Nyayo Tea Zone game barrier.

- The net benefit of the Nyayo Tea Zone as a tool for reducing human-wildlife conflict and for the conservation of montane forest is not known.

"A tea zone does not protect us from wild animals." Joseph Maritim

RECOMMENDATIONS

- Construct a 40.7 km electric game fence, with 14 access gates, along the east boundary of the W Mau FR and along the 2001 excision boundary of SW Mau FR. Communities should be consulted as to the exact location of the access gates. The terrain allows for fence construction.

- Remove all encroachers from SW Mau FR. The encroached area is *ca.* 8.2 km²

- Greatly improve law enforcement in W Mau FR and SW Mau FR.

- Hire forest-adjacent dwellers to undertake large-scale projects to plant indigenous trees throughout the open areas of the former encroached area (190 km²) of SW Mau FR, as well as on former exotic tree plantations within W Mau FR. Protect these trees from browsing by livestock.

- If further evaluation allows, establish projects that substantially increase the production of honey in W Mau FR and SW Mau FR. Where traditional beehives are used, they should be constructed of wood from trees grown outside of Forest Reserves.

- Evaluate the opportunities for butterfly farming as a means of creating jobs and enhancing the value of W Mau FR and SW Mau FR for forest-adjacent dwellers.

- If further evaluation allows, substantially increase the sustainable harvesting of bamboo in SW Mau FR. This will enhance the value of W Mau FR and SW Mau FR for forest-adjacent dwellers and create jobs.

- The Nyayo Tea Zone Development Corporation should evaluate the opportunities for commercial bamboo plantations (both indigenous and exotic species) as a game-proof barrier for (1) protecting montane forest, (2) reducing human-wildlife conflict, (3) creating jobs, and (4) enhancing the value of the W Mau FR and SW Mau FR for forest-adjacent dwellers.

- Establish CFAs all around the W Mau FR and SW Mau FR. Ensure that the Ogiek are heavily involved in CFA decisions and activities.

- Strengthen the CFAs through training, education, participation in decision-making, and problem solving. Support CFA conservation activities (*e.g.*, establishing tree nurseries and planting indigenous trees).

- Move all KFS stations from the excised area to near the SW Mau FR 2001 excision boundary.

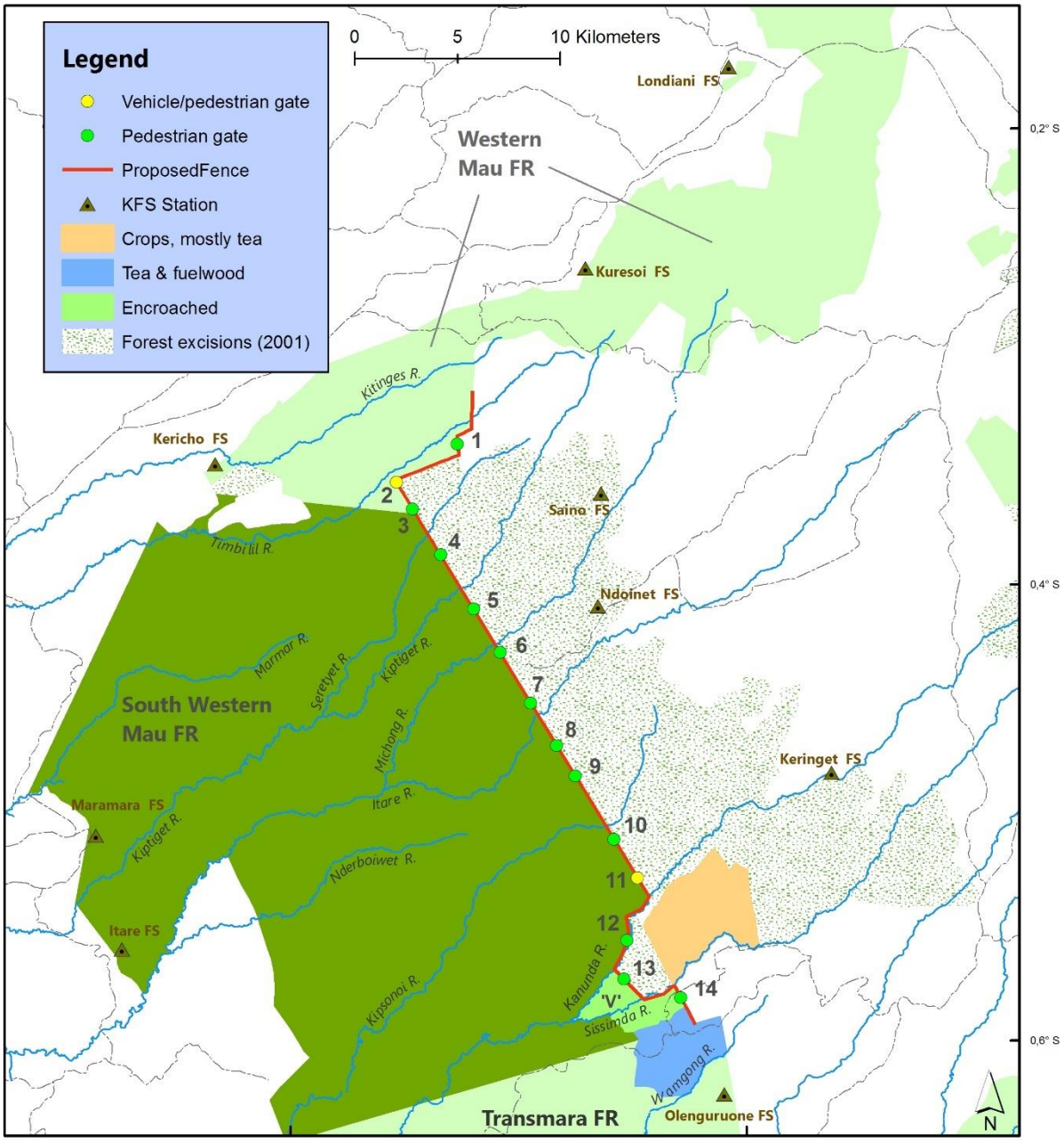

Figure 123. Location of the proposed comprehensive game-proof electric fence with wire mesh and 14 access gates for Western Mau Forest Reserve and South Western Mau Forest Reserve.

- Promote and improve tree growing on farmland, particularly of indigenous tree species.

- Encourage the establishment of more and better schools, and of family planning programmes in the region.

- Undertake a game-proof barrier feasibility study of the 'West Mau Forest Reserve Conservation Corridor' that connects to the SW Mau FR. This vital corridor is now largely comprised of exotic tree plantations and is only *ca.* 1.8 km wide. These plantations should be removed and the corridor planted with indigenous trees.

- Undertake an independent evaluation of the effectiveness of the Nyayo Tea Zone as a tool for reducing human-wildlife conflict and for the conservation of montane forest.

- Undertake an independent evaluation of progress to date towards rehabilitation of the forests and water catchments of the Mau Forests Complex, particularly in the SW Mau FR. What has been achieved to date, how, by whom, and at what cost? What actions have been successful and what actions have failed, and why? What are the lessons learned that can be used to guide future rehabilitation efforts?

It is unfortunate that Kenya finds itself in the position that, in order to protect its vital natural resources and reduce human-wildlife conflict, it must erect physical barriers between people and nature. The 40.7 km comprehensive game-proof electric fence with wire mesh proposed in this report will enable KFS and KWS to (1) control the taking forest products from the W Mau FR and SW Mau FR, and (2) greatly reduce human-wildlife conflict in the region. This should allow for the recovery of the conservation values of these two Forest Reserves, and for the sustainable use of their natural products by forest-adjacent dwellers.

Figure. 124 Commercial honey production, extraction of bamboo, and butterfly farming should be assessed as a means of creating jobs and enhancing the value of the Western Mau Forest Reserve and South Western Mau Forest Reserve for forest-adjacent dwellers.

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APPENDIX 1

Head of Household Questionnaire

QUESTIONNAIRE 1, HEAD OF HOUSEHOLD

Date: Location: S E Village:

Name: Age (years): Male/Female:

Years on farm: Number people in household: Distance farm to forest (m):

Total size farm (acres): ___cropland (%) ___woodlot/forest (%) ___pasture (%)

Number of livestock: ___goats ___sheep ___cows

Three major crops:

---

1. Human-wildlife conflict:

Crop damage: ☐none ☐little ☐a lot

Livestock loss: ☐none ☐little ☐a lot

Damage home/fence: ☐none ☐little ☐a lot

Other:

---

2. What three animals caused the most problems?:

☐Elephant ☐Buffalo ☐Bushpig ☐Porcupine ☐Hyaena ☐Leopard

☐Baboon ☐Blue monkey ☐Colobus ☐Antelope Other:

What methods of protection do you use?:

How much do you use the Forest Reserve?:

Fire wood: ☐none ☐little ☐a lot

Charcoal: ☐none ☐little ☐a lot

Lumber: ☐none ☐little ☐a lot

Poles: ☐none ☐little ☐a lot

Thatching grass ☐none ☐little ☐a lot

Bamboo: ☐none ☐little ☐a lot

Medicinal plants: ☐none ☐little ☐a lot

Grazing: ☐none ☐little ☐a lot

Honey: ☐none ☐little ☐a lot

Meat: ☐none ☐little ☐a lot

Other:

---

3. How do you feel about construction of a fence: ☐unhappy ☐neutral ☐happy ☐no opinion
Why?:

4. Do you prefer a Nyayo Tea Zone or a fence: ☐fence ☐tea zone
Why?:

5. Do you think forest conservation is important? ☐yes ☐no ☐somewhat ☐no opinion

6. What do you think is the best way to protect the Mau Forest?:

7. Do you think there will be enough people in your area to help construct and maintain a barrier?

Post interview notes

Tribe:

Quality of questionnaire: ☐poor ☐fair ☐excellent

Notes:

APPENDIX 2

Officials & Leaders Questionnaire

QUESTIONNAIRE 2, OFFICIALS & LEADERS

Date: Location: S E Village:

Name: Age (years): Male/Female:

Organisation: Position/title: Number of years in area:

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1. In this area, what is the level of human-wildlife conflict?:

Crop damage: ☐none ☐little ☐a lot

Livestock loss: ☐none ☐little ☐a lot

Damage home/fence: ☐none ☐little ☐a lot

Other:

---

2. What three animals caused the most problems?:

☐Elephant ☐Buffalo ☐Bushpig ☐Porcupine ☐Hyaena ☐Leopard

☐Baboon ☐Blue monkey ☐Colobus ☐Antelope Other:

What methods of protection do you use?:

How much is the Forest Reserve used for:

Fire wood: ☐none ☐little ☐a lot

Charcoal: ☐none ☐little ☐a lot

Lumber: ☐none ☐little ☐a lot

Poles: ☐none ☐little ☐a lot

Thatching grass ☐none ☐little ☐a lot

Bamboo: ☐none ☐little ☐a lot

Medicinal plants: ☐none ☐little ☐a lot

Grazing: ☐none ☐little ☐a lot

Honey: ☐none ☐little ☐a lot

Meat: ☐none ☐little ☐a lot

Other:

3. How do you feel about construction of a fence?: ☐unhappy ☐neutral ☐happy ☐no opinion
Why?:

4. What is the community's opinion about construction of a fence?: ☐unhappy ☐neutral ☐happy ☐no opinion
Why?:

5. Do you prefer a Nyayo Tea Zone or a fence: ☐fence ☐tea zone
Why?:

6. Do you think forest conservation is important? ☐yes ☐no ☐somewhat ☐no opinion

7. What do you think is the best way to protect the Mau Forest?:

8. Do you think there will be enough people in your area to help construct and maintain a barrier?

Post interview notes

What is his/her tribe:

Quality of questionnaire: ☐poor ☐fair ☐excellent

Notes: