



AERIAL SURVEY OF THE DESTRUCTION OF THE ABERDARE RANGE FORESTS



Report prepared by:



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FOREWORD

Kenya presents striking contrasts. Over the years, closed-canopy forests have been destroyed and their area reduced to less than two percent of the total land area. At the same time, key economic sectors, including cash and subsistence crop production, tourism and energy generation, have increasingly relied on the environmental services provided by our shrinking forests. Among them, the Aberdare Range forests provide an exemplary illustration of this dichotomy.

As one of Kenya's five main "water towers", the forests of the Aberdares play a critical role in supporting the country's economy. They are the main source of water for Nairobi. 55 percent of Kenya's electricity is generated by water flowing from the Aberdares and Mt. Kenya. However, over the last decades, most of the forests of the Aberdares have been the focus of irregular settlements and large-scale illegal exploitation, such as charcoal production and logging of indigenous trees.

Factual information about what is happening in our forests is important and yet not readily available. I am therefore grateful that the United Nations Environment Programme, Kenya Wildlife Service, Rhino Ark and the Kenya Forests Working Group carried out the aerial survey of the Aberdare Range forests. The report provides unequivocal data on the state of degradation of the Aberdare Range forests. I am dismayed by the wanton destruction wrought upon this invaluable ecosystem, but I am pleased to note the positive impact of some conservation measures, in particular the fencing of forest areas.

The Government is committed to improving the current situation in the Aberdares that calls for urgent policy responses. My Ministry will take effective actions to address forest degradation and to ensure the conservation of the Aberdare forests for the benefit of present and future generations.



Hon. Dr. Newton Kulundu, M.P.
Minister
Ministry of Environment,
Natural Resources and Wildlife

ACKNOWLEDGEMENTS

The request for the aerial survey of the forests of the Aberdare Range was originally presented by Rhino Ark. The objective was to identify the type, extent and location of the threats to the forests and provide an assessment of the impact of fencing on forest conservation. The request was inspired by similar aerial surveys that were undertaken for the forests of Mt. Kenya in 1999 by Kenya Wildlife Service with support from UNEP and for Mt. Kilimanjaro in 2001 by UNEP, Kenya Wildlife Service, University of Bayreuth and the Wildlife Conservation Society of Tanzania with support from UNDP/Small Grants Programme and the United Nations Foundation.

The survey would not have been possible without the support of Mr. Joseph Kioko, former Director of Kenya Wildlife Service, and Mr. Dan Claasen, Acting Director of the Division of Early Warning and Assessment, UNEP, who agreed to detach Mr. Bongo Woodley and Mr. Christian Lambrechts, respectively, to undertake the survey flights and allocate them the time required for the production of the report. Mr. Gideon Gathaara, Chief Conservator of Forests, Ministry of Environment, Natural Resources and Wildlife, endorsed the idea of the aerial survey and expressed full support. The endorsement and support by the authorities have been critical to the successful undertaking of the survey and are very much appreciated.

Rhino Ark, with assistance from Mr. Bill Jordan, UNEP and the Kenya Forests Working Group, with funding from the European Community, provided the much needed funds for the survey and the printing of the report. The views expressed herein are those of the authors and can therefore in no way be taken to reflect the official opinion of the funding organizations.

Finally, we wish to thank Fleur Ng'weno who kindly edited the text of the report and Anthony Mwangi who finalized the layout.

The Survey Team



I. BACKGROUND

In 2002, Rhino Ark requested UNEP, Kenya Wildlife Service (KWS) and the Kenya Forests Working Group (KFWG) to undertake an aerial survey of the Aberdare Range forests, similar to the survey undertaken on Mt. Kenya in 1999 and on Mt. Kilimanjaro in 2001.

The survey responded to increasing public outcry about widespread forest destruction in the Aberdares. Over the past few years, a number of civil society organizations have been reporting on illegal destructive activities in the Aberdare Range forests, in particular on the southern and western slopes. In November 2000, KFWG sent a fact-finding mission to Kieni, Ragia and South Kinangop forests on the south-western slopes. The mission revealed extensive indigenous forest destruction in critical catchment areas, large scale encroachments, as well as rampant charcoal production. Although some few localised actions were taken, the overall situation on the ground did not show any significant improvement. Illegal activities went on unabated in many areas.

Since its inception in 1987, Rhino Ark has launched a number of initiatives aimed at conserving the Aberdares, its habitats and wildlife. These initiatives include the construction of 320 kilometres of fence around the Aberdare Range forests to reduce human-wildlife conflict and protect the natural ecosystem from illegal exploitation. To date some 160 kilometres of fence have been erected and country-wide fund-raising activities are under way to secure the necessary funds for the completion of the fence. In this regard, the survey was to provide Rhino Ark's donors with an accurate appraisal of the situation on the ground and the impact of the fence on the state of conservation of the Aberdares.

It is expected that the information generated through the aerial survey will help all stakeholders to identify appropriate intervention measures to address the threats to the Aberdares. The survey report and the maps can also be powerful awareness-raising instruments that, hopefully, will catalyze the required support at local, national and international levels to ensure the conservation of this invaluable natural ecosystem.

II. GOAL AND OBJECTIVES

The main goal of the aerial survey was to provide factual information on the type, magnitude and location of the main threats to the forests of the Aberdare Range. It will help stakeholders to determine the effectiveness and weaknesses of current management practices and to adopt new policy and management decisions for the long-term conservation of the forests. The specific objectives were to:

- (a) Categorise the type, magnitude and location of the threats, in particular destructive activities, in the forests of the Aberdare Range;
- (b) Provide a well documented, systematic and factual assessment of the current threats to the forests that could be useful for improved management;
- (c) Enhance awareness of the current threats to the forests and the value of the mountain ecosystems; and,
- (d) Assess the impact of fencing the Aberdares on the conservation of the forests.



III. BRIEF DESCRIPTION OF THE ABERDARE RANGE FORESTS

A. Overall description

The Aberdare Range is located in central Kenya on the Equator. The Range stretches over 125 kilometres from Nyahururu in the North to Limuru in the South. It is the third highest mountain in Kenya, with two main peaks, Oldonyo Lesatima (also known as Sattima) and Kinangop, which reach, respectively, altitudes of 4,001 and 3,906 metres. The Range presents a deeply dissected topography sloping gradually to the east. In contrast, the western side drops along impressive fault escarpments towards the Rift Valley.

The climate of the Aberdare Range is generally characterised by two rainy seasons - from April to May, and October to November. Rainfall varies with altitude and exposure to the dominant wind from the Indian Ocean, but reaches a maximum of around 2,600 mm annually on the south-eastern slopes and drops to less than 900 mm a year on the northern and south-western lee slopes.

Various vegetation zones can be distinguished on the Aberdare Range, including the closed-canopy forest belt, the bamboo zone, the sub-alpine and alpine vegetation. The forest belt covers a major part of the range. Most of the forest is gazetted as forest reserves. However, parts of the upper forest zone fall within the Aberdare National Park.

The forest belt of the Aberdare Range is characterised by a high diversity of forest types, because of the wide altitudinal range (from 1,800 to 3,600 metres) and the climatic differences between the slopes.

B. Water Catchment

The Aberdare Range plays a critical role in water catchment for the country and is one of the five main “water towers” of Kenya with Mt. Kenya, Mau Complex, Cherangani Hills and Mt. Elgon, all providing most of the nation’s water.

The Aberdares are the main catchments for Sasumua and Ndakaini dams, which provide most of the water for Nairobi - a city of more than two millions people.

The eastern slopes are catchments of the Tana River, Kenya’s largest river, that supplies water to the Seven Forks hydropower plants where over 55 percent of Kenya’s total electricity output is generated. It also feeds major irrigation schemes such as Mwea rice scheme, Bura settlement scheme and the Tana Delta irrigation scheme. The south-eastern slopes form the upper catchments of the Athi River, the main tributary of the Sabaki River that drains into the Indian Ocean. The northern slopes are catchments for the Ewaso Nyiro River, the main river crossing the semi-arid Laikipia plateau and the Samburu plains and deserts beyond. The Malewa River, the major surface source of water for Lake Naivasha, originates from the north-western slopes. The adjoining districts and, in particular, the high densely populated areas on the eastern and southern slopes rely primarily on the water flowing from the Aberdare Range (Map 1).

C. Biodiversity

Ecosystems

The Aberdares have a rich diversity of vegetation types that result mainly from the wide range in altitude and rainfall (see Table 1 and Map 2).

Flora

The Aberdares host a wide variety of plant species. A study carried out in 1986-88 identified 778 species, subspecies and varieties in the Aberdare National Park alone (Schmidt, 1991).

Common hardwood tree species include Camphor (*Ocotea usambarensis*), Cedar (*Juniperus procera*), Podo (*Podocarpus*



latifolius) and *Hagenia* (*Hagenia abyssinica*). Other notable plants include the Aberdares endemics: *Lobelia deckenii sattimae* and *Helichrysum gloria-dei*, and the Aberdare/Mt. Kenya endemics *Lobelia bambuseti* and *Senecio keniodendron*.

Table 1: Major vegetation types of the Aberdares*

Vegetation zone	Altitude (m asl) / Location	Characteristic tree (and shrub) species
Montane forest zone - Moist forest	1900 - 2500 / East 2100 - 2500 / South-East	- <i>Cassipourea malosana</i> , <i>Ekebergia capensis</i> , <i>Teclea nobilis</i> , <i>Calodendrum capense</i> , <i>Podocarpus latifolius</i> , <i>Nuxia congesta</i> - <i>Ocotea usambarensis</i> , <i>Macaranga kilimandscharica</i> , <i>Neoboutonia</i> <i>macrocalyx</i> , <i>Tabernaemontana stapfiana</i> , <i>Prunus africana</i>
- Dry forest	1800 - 2400 / South-West 2400 - 3300 / West 2300 - 3200 / North, North-East	- <i>Juniperus procera</i> , <i>Calodendrum capense</i> , <i>Teclea simplicifolia</i> - <i>Juniperus procera</i> , <i>Olea europaea (africana)</i> , <i>Podocarpus</i> <i>falcatus</i> , <i>Nuxia congesta</i>
Bamboo zone	2400 - 3000 / East, South-East 2700 - 3300 / West	- <i>Arundinaria alpina</i> with scattered trees, including <i>Podocarpus latifolius</i> and <i>Nuxia congesta</i>
Hagenia-Hypericum zone	2950 - 3500 (discontinuous)	- <i>Hagenia abyssinica</i> , <i>Hypericum revolutum</i> , <i>Rapanae</i> <i>melanophloeos</i>
Ericaceous zone	2900 - 3560 (discontinuous)	- <i>Erica excelsa</i> , <i>Erica trimera</i> , <i>Erica arborea</i> , <i>Cliffortia nitidula</i> , <i>Helichrysum nandense</i> , <i>Strobe kilimandscharica</i>

*The description of the main vegetation types is based on the work by Ng'ang'a (1990), Schmidt (1991) and KIFCON (1994).

The description aims at providing an overview, but does not give a detailed account of the vegetation cover.

Fauna

The Aberdare Range forests host a number of threatened fauna species. The Jackson mongoose (*Bdeugale jacksoni*), endemic to Kenya's montane forests and the rarely seen golden cat (*Felix aurata*) are two threatened mammals. Other large threatened mammals of international conservation interest that occur in Aberdare forests are bongo (*Tragelaphus euryceros*), giant forest hog (*Hylochoerus meinertzhageni*), black rhino (*Diceros bicornis*), elephant (*Loxodonta africana*), leopard (*Panthera pardus*) and African hunting dog (*Lycaon pictus*). In addition, the forest harbours bushbuck (*Tragelaphus scriptus*), mountain reedbuck (*Redunca fulvorufula*), waterbuck (*Kobus ellipsi prymnus*), cape buffalo (*Synkerus caffer*), suni (*Neotragus moschatus*), side-striped jackel (*Canis adustus*), eland (*Taurotragus oryx*), and varieties of duikers and bushbabies.

The forests are rich in primates, the common ones include the black-and-white colobus monkey (*Colobus guereza*), sykes monkey (*Cercopithecus mitis*), vervet monkey (*Cercopithecus aethiops*) and baboons (*Papio anubis neumanni*).

The Aberdare Range is internationally recognized as an Important Bird Area (IBA). The Range holds 52 of Kenya's 67 Afrotropical highland species and six of the eight restricted range species in the Kenyan montane endemic bird areas. Over 270 species of birds have been recorded in the Aberdares including the following globally threatened and restricted-range species: Sharpe's Longclaw, Abbott's Starling, Aberdare Cisticola and Jackson's Widowbird. Regionally threatened species found in the Aberdares include Cape Eagle Owl, African Crowned Eagle, and African Green Ibis. Jackson's Francolin, Hartlaub's Turaco and Bar-tailed Trogon are characteristic and spectacular birds of the Aberdare Range.

The Aberdares also hold several amphibians that are endemic to the central Kenyan highlands including *Hyperolius montanus*, *Hyperolius cystocandicans*, *Rana wittei* and *Phrynobatrachus kinangopensis*.



D. Tourism potential

The Aberdares have the distinction of being the first wildlife area in Kenya to boast a game viewing facility. This was started in the 1930s on farmland, before being encompassed in the National Park as gazetted in 1950. Called Treetops, it was a simple tree platform on which guests could sit up during the night to see animals drinking at a waterhole. Today the fully functional lodge by the same name and the Ark lodge – both sited in the Salient are some of Kenya's prime game viewing lodges. The Salient is the eastern extension of the National Park that crosses the forest belt and reaches the settlements.

The Aberdare National Park receives an average 50,000 visitors annually. Most visitors stay in the night viewing lodges but the Salient is frequented by mobile safari operators who rent designated campsites. Game viewing on the 290 kilometres of track in both the Salient and the moorland is very productive.

The scenery is spectacular and the high upland waterfalls are a special attraction. Many visitors either camp overnight or travel for a day from Nairobi and the other nearby towns of Naivasha, Nyeri and Nakuru to enjoy the scenery, licensed trout fishing and hiking to the mountain peaks.

The north and south east of the park are as yet undeveloped but have unique attractions. KWS has identified sites in the south with potential for forest walks and hiking routes to Kinangop peak. In the north, areas for fishing, hiking and horse riding have been identified. There are campsites and a road network.

The tourism potential of the Aberdares remains largely untapped.

E. Medicinal and other economic benefits

The forests of the Aberdares yield a wide range of non-timber forest products, many of which are consumed only at the household level. These range from medicinal plants to sources of wild honey, wild fruits, fibres for ropes, baskets and mats.

The non-market value of such forest resources is immense. The economic benefits of the Aberdares for forest adjacent households are estimated as US\$ 165 per household per year (Emerton et al, 1998).

F. Conservation measures and fencing

The Aberdare Range remains one of Kenya's most important forest and water catchments. It is estimated that at least one in three people in Kenya depends in some way on the natural resources of the Aberdare Range.

Its foothills and lower slopes are some of the most productive farmlands in Kenya – giving a livelihood to millions of people. There is a sensitive boundary between the forest habitat and its wildlife, and the high-density farmland adjoining the forest. It represents an area of high human-wildlife conflict and illegal forest exploitation. But it is also now an area where the marauding of wild animals into farmland is being successfully prevented by the construction of an electrified game proof fence.

The fence is supported by voluntary contributions from thousands of Kenyans who wish to conserve this vital ecosystem. Half the fence has now been built – a length of 160 kilometres. Rhino Ark has scheduled that the remainder of the fence is targeted for completion by the year 2005 – subject to funds being available for its continued construction. The total area to be fenced will be in the region of 1,760 square kilometres.



IV. A BRIEF ON THE FOREST SECTOR

A. Overview

Kenya's closed-canopy forests were estimated by the Kenya Indigenous Forest Conservation Programme (KIFCON) of 1991-1994 to cover 1.24 million hectares. This is just about two percent of the country's land area. Recent estimates based on remote sensing indicate that Kenya's forest cover now stands at a critical 1.7 percent (UNEP, 2001). This is against a global average forest cover of 21.43 percent, and an average for Africa of 9.25 percent. Plantation forests are estimated to cover 120,000 hectares.

The greater part of closed-canopy indigenous forest cover occurs in large gazetted montane forest blocks. Closed-canopy forest is climatically restricted to the 12 percent of the country classified as semi-humid to humid, predominantly within the Central Highlands and the Nyanza Plateau. Within this area, closed-canopy forest is further restricted to land below about 3,200 meters. The exceptions to this geographically limited area are forests occurring as islands on top of inselberg structures in the lower parts of the country; riverine forests; and, forests in the narrow coastal belt with rainfall of over 1,000 mm (Wass, 1995).

Kenya's forests play many important roles: they trap and store rain water; regulate river flow and prevent flooding; help recharge ground water tables; improve soil fertility; reduce soil erosion and sediment load in river water; help regulate local climate conditions; and, act as carbon reservoirs and sinks. They also serve as cultural, ceremonial and recreational sites and provide a variety of wood and non-wood products.

The crucial role in soil and water conservation provide strong linkages with agriculture and tourism, which are the mainstay of the national economy. The agricultural sector contributes 30 percent of the GDP and provides the main livelihood for about 80 percent of the population. It employs 70 percent of the labour force, provides a large portion of the national food requirements and is a major source of export earnings.

Forests are major habitats of wildlife - an important feature for the tourism industry that in 1995 accounted for 38 percent of foreign exchange earnings and contributed eight percent of total employment in the country. Recent local and international security events have caused a drop in Kenya tourist arrivals, but domestic tourism is taking on greater importance.

Forests play a critical role in water catchment for the country. According to a survey carried out by the Forest Department (FD), the value of indigenous forests as water catchments was approximately Kshs. 2,050 per hectare per year in 1994 (MENR, 1994). Close to three-quarters of Kenya's electricity is derived from hydropower. Forests contribute to the availability of water for electrical power generation, especially because of their role as water catchments and in reducing siltation of hydroelectric dams.

About 71 percent of the domestic energy consumed in the country comes from wood. Out of the 20 million cubic meters of fuelwood consumed annually, 95 percent is collected from forests and rangelands (MENR, 1994).

Many forests are traditionally important for cultural ceremonies and as sacred sites to local communities, and specific tree species have cultural values.

It is estimated that 530,000 forest-adjacent households (which amount to 2.9 million people living within five kilometres from forests) derive direct benefits from indigenous closed-canopy forests. This amounts to 10 percent of Kenya's population (Wass, 1995). Estimates indicate that in some areas, the forestry sector contributes about 70 percent of the forest adjacent households' cash income (Wass, 1995).

B. Management

The majority of Kenya's forests are gazetted as forest reserves. In 1994, their total area amounted to 1,687,390 hectares. They are on government land and include the majority of large, closed-canopy forest blocks such as the Aberdare Range, Mt. Elgon and the Mau complex, as well as the forest plantations. The management of gazetted forest reserves is vested in FD.



There are also closed-canopy forests gazetted as national parks and national reserves managed by KWS. Some gazetted forest reserves of high biodiversity significance are managed by FD and KWS through a Memorandum of Understanding, such as the Aberdare Forest Reserve. Since the early 1990s forests of cultural and biodiversity significance have been gazetted as National Monuments under the Antiquities and Monuments Act and their management vested in the National Museums of Kenya. Key among these are Kaya Sacred forests found in the Coast Province; the City Park in Nairobi, the Gede Ruins, the Njuri Njeke in Meru and the Mukurwe Wa Nyagathanga in Muranga.

An estimated 100,000 hectares of forest are found in trust land and vested in the respective local authorities under the Ministry of Local Government.

There are also indigenous forest areas under private ownership, either as units held individually or within Group Ranches. Many of these usually small holdings are important for catchment and streamline conservation purposes as well as providing subsistence and small-scale commercial produce.

The main challenge that confronts the forest sector is the inability of institutions to respond to realities of the Kenyan society and new approaches to natural resource management. For about 25 years, the country continued to be guided by a Forest Policy that was formulated in 1957 and slightly revised in 1968. Forests have also been under-valued by the Government, which has led to insufficient funding being allocated to the forestry sector, in particular FD. The result has been degradation of the country's forest resources.

V. METHODOLOGY

The methodology for the aerial survey of the Aberdare Range forests was derived from the long experience gained by East African wildlife departments in counting animal numbers from aircraft following set transects, further adapted as a result of the first ever forest survey of its kind of Mt. Kenya in 1999 (Gathaara, 1999) followed by the survey of Mt. Kilimanjaro in 2001 (Lambrechts, 2002). The principal difference was that the occurrence of forest destruction often had to be viewed from vertically overhead, necessitating a series of continuous loops either side of the transect, in a "figure of eight" pattern.

The aircraft used was a tandem-seat Aviat Husky. The crew consisted of a pilot and a rear-seat observer (RSO) who were based at Naro Moru for the survey of the northern part of the Aberdares and in Nairobi for the southern part.

The aircraft was equipped with a Global Positioning System (GPS) Garmin GPSMap76S receiver, able to track the flight path of the aircraft on a "rover file", and was set to record position every five seconds. This recorded a detailed and accurate map of the actual flight paths and included the exact flight pattern each time the aircraft left the transect in order to get a better look at the extent of damage or observed threat. The exact position of each observation was recorded as a waypoint in the GPS waypoint file that was later downloaded into a Geographical Information System (GIS) database. The data from the survey is deposited at the UNEP/DEWA office in Nairobi. The types of damage and threats to the forest were recorded as follows:

- Logging of indigenous trees:
 - Camphor (*Ocotea usambarensis*) and
 - Cedar (*Juniperus procera*);
- Logging of other indigenous tree species;
- Charcoal production;
- Cultivation of marijuana (*Cannabis sativa*);
- Other cultivated fields in the indigenous forest;
- Settled encroachments;
- Shamba-system practices;
- Livestock grazing;
- Burnt forest areas;
- Landslides;
- Quarries.



A. Reconnaissance flights

Prior to the aerial survey, reconnaissance flights familiarized the crew with the forest areas to be surveyed. On the basis of these flights, the crew became familiar with the topography of the area and the forest boundaries. Pre-assessments of the level of disturbances were made to help select the most appropriate flight paths for each area (see section C), and the most targeted tree species were identified.

B. Survey blocks

The aerial survey covered all forests of the Aberdare Range, including the Aberdare Forest Reserve (FR), Kikuyu Escarpment FR, Kipipiri FR, South Laikipia FR, Nyeri FR, Nyeri Hill FR, Kiganjo FR, Nyamweru FR, Kingatua FR, Kijabe Hill FR, Magumo South FR, Magumo North FR, Kirima and Muruai forests. The survey also covered all forests within the Aberdare National Park. The surveyed area was divided into 16 blocks (Map 3), demarcated by easily discernible boundaries such as rivers and roads. The actual survey occupied 61 hours of flight time (see Table 2).

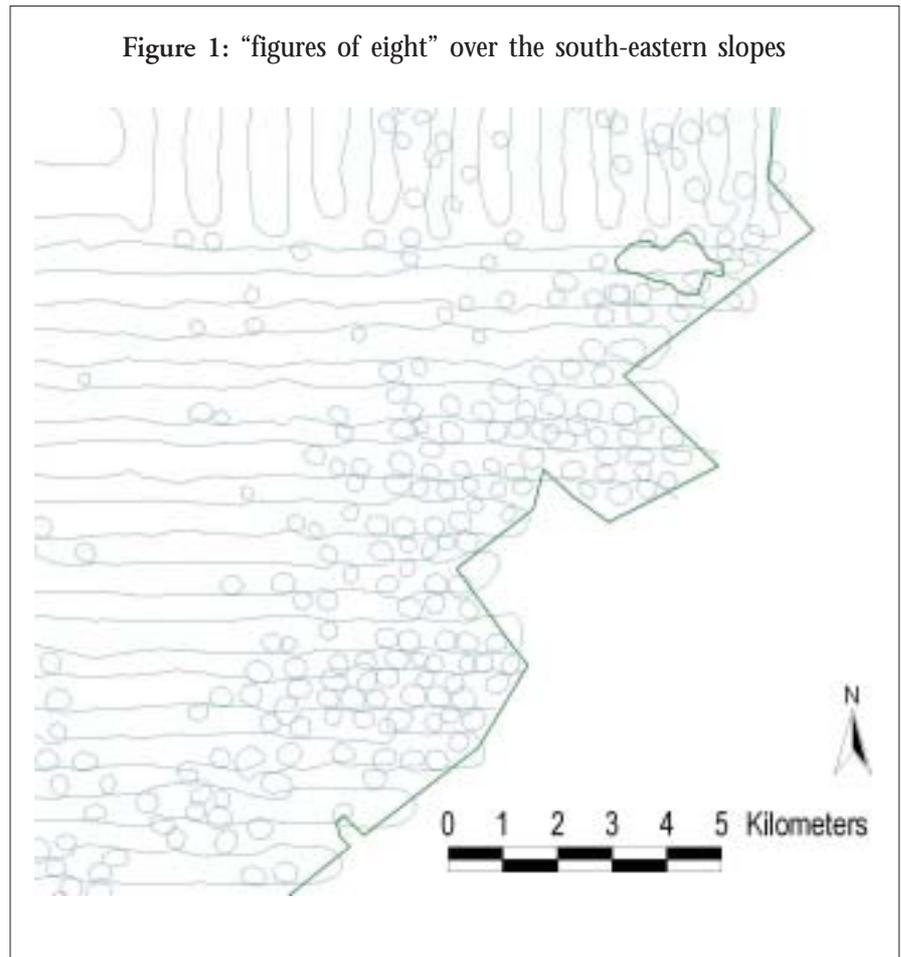
Table 2: Flight time and count time

Date	Take off	Landing	Flight time (hours)	Count on	Count off	Count time (hours)	Block
20-Aug-02	13:15	16:10	2:55	13:43	15:43	2:00	N
30-Aug-02	14:32	16:55	2:23	14:51	16:28	1:37	N
31-Aug-02	12:12	16:09	3:57	12:35	15:26	2:51	N
1-Sep-02	13:10	16:14	3:04	15:26	15:47	0:21	NE
				13:25	14:40	1:15	SLS
				14:44	14:56	0:12	SLN
3-Sep-02	12:50	16:08	3:18	15:04	15:49	0:45	NE
				13:07	13:51	0:44	NE
				13:58	15:44	1:46	SAL
16-Oct-02	14:20	17:04	2:44	14:35	16:43	2:08	E
17-Oct-02	13:57	16:44	2:47	14:15	16:25	2:10	E
18-Oct-02	14:38	17:06	2:28	14:58	16:44	1:46	SE
19-Oct-02	13:06	17:17	4:11	13:33	16:38	3:05	SE
21-Oct-02	12:38	15:59	3:21	13:08	15:30	2:22	W
22-Oct-02	12:47	16:54	4:07	13:27	16:23	2:56	KIP
24-Oct-02	14:08	16:56	2:48	14:24	16:22	1:58	ESC
25-Oct-02	13:07	17:42	4:35	13:51	17:10	3:19	SW
29-Oct-02	13:39	16:30	2:51	14:01	14:04	0:03	ESC
				14:11	14:20	0:09	MAG
				14:23	14:49	0:26	ESC
				14:51	14:55	0:04	ESC
				14:58	15:23	0:25	NYA
30-Oct-02	14:14	18:13	3:59	15:24	16:14	0:50	KIK
7-Nov-02	13:54	16:16	2:22	14:45	17:50	3:05	S
8-Nov-02	13:47	16:06	2:19	14:14	15:57	1:43	KIK
8-Nov-02	13:47	16:06	2:19	14:06	15:46	1:40	KIK
12-Nov-02	14:22	17:15	2:53	14:51	16:45	1:54	KIK
13-Nov-02	13:04	17:02	3:58	13:20	13:50	0:30	NYE
				14:08	16:31	2:23	KIK
Total flight time			61:00	Total count time		44:27	



C. Selection of flight paths

Flight paths were selected so as to limit climbing or descending along each transect. They were run east-west (or vice-versa) or north-south (or vice-versa) depending on the direction of slope in each block (Map 4). Transects were spaced from between 0.5 to 1 kilometre apart, depending on the extent of forest damage witnessed. In areas where disturbances were not recent, transects were one kilometre apart. In areas moderately disturbed, the transects were 500 metres apart in order to document the disturbance activities in the forest more precisely. In heavily disturbed areas, figures of eight were carried out on either side of the transects to enable a more thorough survey of the disturbances (Figure 1). Overlapping between “figures of eight” carried out on adjacent transects was avoided thanks to the display features of the GPS receiver used during the flights.



D. Data recording

The pilot navigated and recorded each observation into the GPS receiver. The RSO took photographs, and recorded the information related to each observation on a data sheet in consultation with the pilot. Both crew attempted to spot and assess disturbance in the forest.

GPS positions of observed disturbances are affected by inbuilt imprecision of the GPS system and the time lapse between eye observation and subsequent logging of the actual position into the GPS. As a result, GPS position of disturbances may be slightly off the actual position on the ground; the GPS positions of disturbances on the edges of the forest reserves may appear on the maps slightly outside the boundaries.

The recording of disturbance was restricted by aircraft aerial visibility, since disturbance concealed by the canopy was not seen. Tall trees, deep valleys, obscured angles and sunlit tree tops that enhanced dark shadows all affected what was actually seen and recorded. As a result, the recorded observations provide an indication of the extent of the actual disturbance rather than a complete and accurate picture.

For each observation, the following data were recorded:

- Waypoint number as indicated on the GPS;
- Type and extent of disturbance;
- Frame numbers;
- Comments made by the pilot or the RSO.

For the small cultivated fields and the marijuana fields, the extent of the disturbances was estimated in hectares on the basis of counting the number of football pitches (0.5 hectare) that could fit in each of the fields under observation.



E. Photo records

Most observations are illustrated by photographs. In particular, Shamba-system areas are documented by at least one photograph. Photographs were taken with a digital still camera Fujifilm model 4700.

F. Data processing in the field

Immediately on landing, the RSO downloaded the digital photographs, the GPS rover files and the observation waypoint files into a lap-top computer using the software ArcView version 3.2 and the extension DNRGarmin version 1.2.4. developed by the Minnesota Department of Natural Resources. Maps of the flight lines and the observation waypoints were then printed to identify any double observations within each block and to cross check with the flight lines as to whether or not the area to be surveyed had been completely covered.

G. Data interpretation and analysis

Further analysis was carried out in Nairobi. All data were copied from the data-sheets to an MS-Excel spreadsheet where they were merged with the GPS data (position, date and time). All the MS-Excel data records were then transferred into a GIS using the ArcView version 3.2 software. The boundaries of the forest reserves incorporated in the GIS were based on the 1991-1994 datasets prepared under the KIFCON Programme, FD. Spatial data on the location of the fence was derived from Butynski (1999) and an aerial survey undertaken in 2002. Digital photographs were used to cross check the information recorded on the data sheets.

VI. RESULTS OF THE AERIAL SURVEY

A. Overall description of current threats to the forests

The Aberdare Range forests are heavily impacted by illegal charcoal production in most areas on the western, southern and south-eastern slopes. Illegal logging of indigenous trees is a major concern across the entire Range, in particular the logging of Cedar trees that extensively affect the northern and western slopes. Illegal cultivation of crops and settlements present a major threat to the integrity of the ecosystem, having already led to the destruction of well over 6,100 hectares (Map 5).

Southern slopes of the Aberdare Range

Illegal activities affect the entire mixed broadleaf forest. The moist *Ocotea* forests that cover most of the southern slopes are undergoing serious destruction caused by the intensive charcoal production and illegal logging. During the survey, over 10,000 charcoal kilns were counted. In the drier forest that covers the escarpment bordering the Rift Valley, charcoal production had led to the destruction of over 80 percent of the forest canopy in many areas.

Over 2,800 recently-logged indigenous trees were counted. Although Camphor trees used to be a dominant species in most areas on the southern slopes, only 272 recently-logged Camphor trees were counted. Past depletion of the Camphor stand explained this low number.

Livestock grazing presents a major threat to forest regeneration, with over 5,700 head counted on the southern slopes.

Western slopes of the Aberdare Range

Logging and charcoal production also impact heavily on the western slopes. Over 2,000 recently-logged Cedar trees were counted, as well as some 1,100 other indigenous trees, in addition to over 3,500 charcoal kilns. The cumulative impacts of illegal logging and charcoal production has opened up most of the forest areas that cover the steep slopes along the western fault escarpment and the ridges emanating from Kinangop peak.



Large tracts of forests have been destroyed and irregularly converted into settlements, including 4,475 hectares around Kipipiri and 1,104 hectares in Ragia forest.

Northern slopes of the Aberdare Range

The northern tip of the Range is mostly grassland with scattered clusters of trees. These remaining clusters, located outside the fence, are the target of illegal activities, mainly charcoal production and logging of Cedar. Well over 5,100 heads of livestock were observed in that area, most likely leading to overgrazing and inhibiting regeneration.

Eastern slopes of the Aberdare Range

Logging of indigenous trees and illegal cultivation are the two major threats to the eastern slopes. Over 1,800 recently logged Cedar trees were recorded, as well as some 2,750 other indigenous trees. In the northern block of South Laikipia Forest Reserve, past logging activities has led to the removal of over 90 percent of the forest cover. Some 49 cultivated fields in the indigenous forests were found near Chinga. In addition, the survey identified 16 small marijuana fields, most of them being planted or partially planted.

The majority of the clear felled forest plantations under the Shamba-system have not been replanted with young trees, as required by the normal rotation management.

B. Logging of indigenous trees

The survey recorded recent logging of indigenous trees in the natural forest (Maps 6, 7 and 8). Two of the most targeted species were identified separately: Camphor (*Ocotea usambarensis*) and Cedar (*Juniperus procera*). The others are grouped under the category “other indigenous tree species” (Table 3).

Table 3: Logging of indigenous trees

Tree species	Number of trees		
	Inside fenced forest	Unfenced forest	Total
Camphor	0	272	272
Cedar	936	3,510	4,446
Other indigenous tree species	208	4,499	4,707
Total	1,144	8,281	9,425



Photograph 1: Logging of Cedar trees on the western slopes



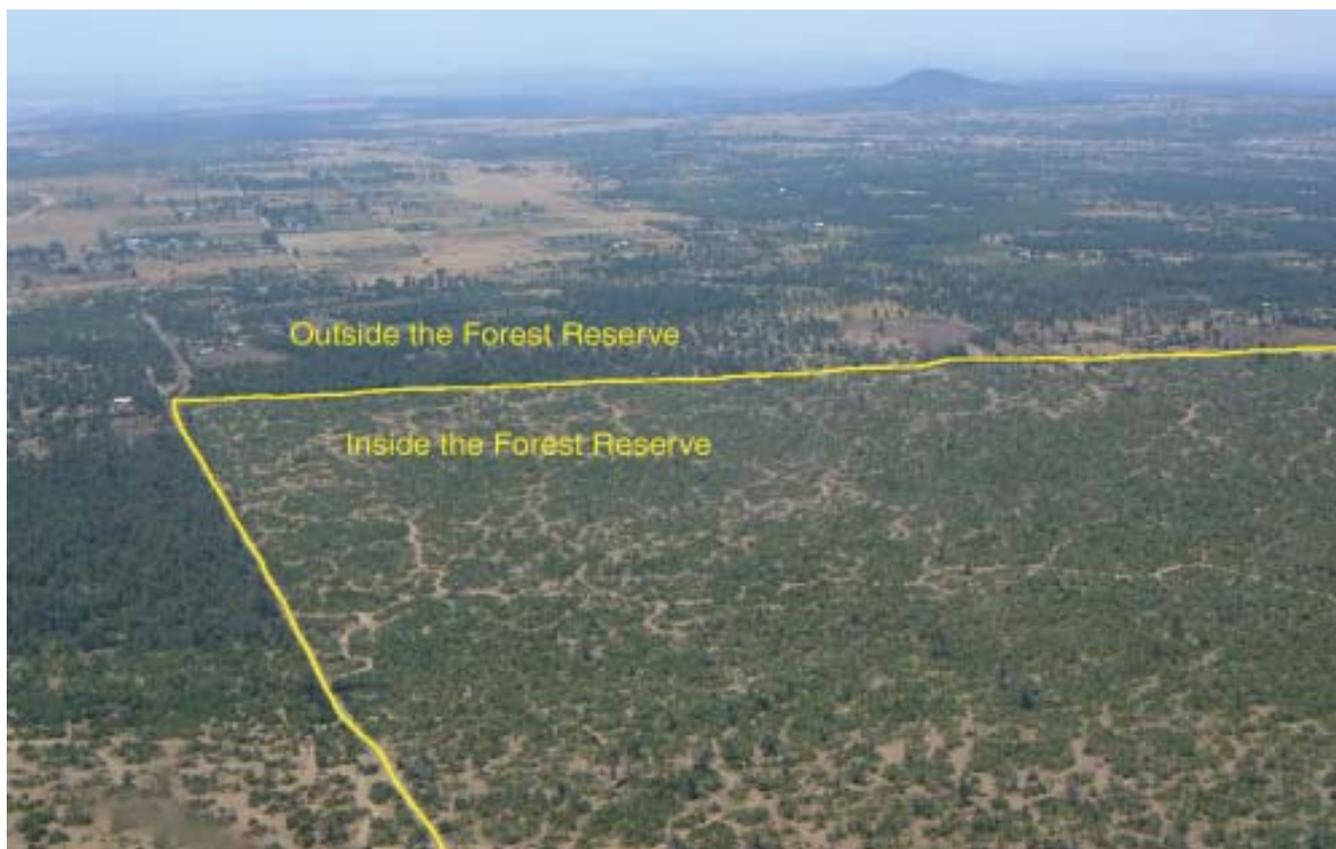


Photograph 2: Logging of Cedar trees on the south-western slopes



Photograph 3: Logging of Cedar trees on the western slopes





Photograph 4: Extensive destruction of forest cover in the northern block of South Laikipia Forest Reserve. Most trees, mainly Cedar, have been logged to such extent that there are more trees on private land than in the Forest Reserve.

C. Charcoal production

Some 14,499 charcoal kilns were counted in the forests of the Aberdare Range (Map 9). The majority of the kilns were located on the southern slopes (68 percent) and western slopes (25 percent) (Table 4). In many areas on these slopes, charcoal production led to extensive destruction of the forest cover, in particular on the escarpment along the Rift Valley, on the western ridges emanating from Sattima and Kinangop peaks and along the eastern boundary of the Kikuyu Escarpment Forest Reserve. Less than 0.2 percent of the kilns were observed within the fenced forest areas on the northern and western slopes.

None of the recorded charcoal kilns were overgrown with vegetation. They were active or recent and most likely not older than one year.

Table 4: Charcoal production

Location	Number of charcoal kilns
Southern slopes (unfenced forest)	9,978
- Kijabe Hill FR	1
- Kikuyu Escarpment FR	4,628
- Kikuyu Escarpment FR (fault escarpment)	5,200
- Kingatua FR	16
- Nyamweru FR	133
Western slopes (unfenced forest)	3,601
- Aberdare FR	3,161
- Kipipiri FR	440
Northern slopes	406
- Aberdare FR (inside fenced forest)	5
- Aberdare FR (outside fenced forest)	401
Eastern slopes	514
- Aberdare FR (inside fenced forest)	20
- Aberdare FR (outside fenced forest)	312
- Kiganjo FR (no fence)	20
- Nyeri FR (no fence)	120
- South Laikipia FR (no fence)	42
Total	14,499





Photograph 5: Large-scale charcoal production on the south-eastern slopes near Chania River .



Photograph 6: Large-scale charcoal production on the south-eastern slopes near Gacharge.





Photograph 7: Large-scale charcoal production on the southern slopes near Linenjeke (Uplands).



Photograph 8: Large-scale charcoal production on the western slopes near Kipipiri.





Photograph 9: Massive charcoal kiln on the south-eastern slopes near the Chania River.
The approximate dimensions of the kiln are 3 x 22 metres.

D. Cultivation of marijuana (*Cannabis sativa*)

Some 16 marijuana fields were recorded, covering a total area of approximately 3 hectares (Map 10). All marijuana fields were found on the eastern slopes near Endarasha, Chinga and Wanjerere. 13 of the marijuana fields were inside fenced forest.

Marijuana fields are described in terms of status (Table 5). Identified status include: planted, partially planted, and in preparation.

Table 5: Cultivation of Marijuana

Status	Number of fields
Planted	4
Partially planted	9
In preparation	3
Total	16





Photograph 10: Planted marijuana field near the Gura River (Munyange).



Photograph 11: Marijuana field in preparation near Enderasha.



E. Cultivated fields in the indigenous forest

Some 146 cultivated fields were found in the indigenous forest (Map11). These fields are not within the forest plantation areas and do not fall under the Shamba-system. They are illegal encroachments into the indigenous forests. The majority of them (83) were located on the eastern slopes near Chinga (Table 6). They were mostly planted with tobacco. The other fields were mainly found near the forest boundaries and planted with maize.

Table 6: Cultivated fields

Location	Number of fields
Eastern slopes near Chinga - inside fenced forest - unfenced forest	30 53
Elsewhere (unfenced forest)	63
Total	146



Photograph 12: Cleared / cultivated fields in the indigenous forest near Chinga.





Photograph 13: Fields planted with tobacco on the eastern slopes near Chinga.

F. Settled encroachments

Five large forest areas were found to be under settlements (Map 12). They include the entire Magumo South Forest Reserve and Magumo North Forest Reserve, and large areas in Ragia and Kipipiri forests. These large settlements cover approximately 6,181 hectares (Table 7). In addition, eight small settled encroachments were recorded in the forest reserves. They were located near Kirurumi (Nyeri), Kinale and along the boundary of the southern block of South Lakipia Forest Reserve.

Table 7: Main settled forest areas

Location	Hectares	Impacted forest reserves	Legal status and background
Kipipiri (north)	3,796	Kipipiri FR/Aberdare FR	Gazetted forest reserve; known as Geta and Mikaro Settlement Scheme; settled in the 1970s
Kipipiri (south)	679	Kipipiri FR/Aberdare FR	Gazetted forest reserve; known as Geta Settlement Phase II; settled in the 1970s
Ragia forest	1,104	Kikuyu Escarpment FR	Gazetted forest reserve; settled in 1965
Magumo North FR	239	Magumo North FR	Gazetted forest reserve since 1978.
Magumo South FR	363	Magumo South FR	Gazetted forest reserve since 1979
Total	6,181		





Photograph 14: Settled forest areas near Kipipiri.



Photograph 15: Small settled encroachments on the eastern slopes near Kirurumi (Nyeri).



G. Shamba-system practices

Forest plantations in Kenya have usually been established by allowing local farmers to inter-crop annual agricultural crops with tree seedlings in forest plantation areas until the third year of tree growth. By the third year, the young tree canopy casts too much shade for the normal growth of agricultural crops. At this point, farmers move out and are allocated other plots, if available. This agro-forestry practice, commonly called “Shamba-system” or Non-residential Cultivation, is based on the successful experience of establishing teak plantations in Burma (Myanmar) since the middle of the 19th century. It was identified as a means of providing cheap labour, even free, for establishing forest plantations, contributing to national food production and the creation of rural employment.

Table 8: Shamba-system practices

The survey recorded the status of forest plantation areas under the Shamba-system (Map 13). Four different categories were identified: areas not planted with tree seedlings, those partially planted, those fully planted and areas encroaching into neighbouring indigenous forest (Table 8).

Status of Shamba-system areas	Number of areas	%
Not planted with tree seedlings	159	69
Partially planted with tree seedlings	14	6
Planted with tree seedlings	49	21
Encroaching	8	4
Total	230	100



Photograph 16: Shamba-system areas not planted with young trees on the eastern slopes.





Photograph 17: Shamba-system areas not planted with young trees on the south-western slopes.



Photograph 18: Encroachment emanating from Shamba-system areas on the eastern slopes.



H. Livestock grazing

Large herds of livestock were found on the northern slopes (Map 14). In total, 18,497 head of livestock were counted, of which 2,104 were seen inside fenced forest areas. Goats and sheep were grouped together as “shoats”, and cattle were counted separately (Table 9).

Table 9: Livestock grazing

Livestock grazing	Northern slopes		South-western / western slopes		South-eastern / eastern slopes		Total
	No. of Heads	Average No. of heads/ herd	No. of Heads	Average No. of heads/ herd	No. of Heads	Average No. of heads/ herd	
Cattle	1,577	25	2,022	11	2,766	12	6,365
Shoats	4,497	71	5,049	45	2,586	24	12,132
Total	6,074	48	7,071	23	5,352	16	18,497

Table 10: Burnt forest areas

I. Burnt forest areas

The survey recorded 21 burnt indigenous forest areas (Map 15). The majority of these areas were found on the northern slopes and on the southern slopes along the fault escarpment overlooking the Rift Valley (Table 10). Eight of them were inside fenced forest areas.

Location	Number of burnt forest areas
Northern slopes	10
Escarpment on the southern slopes	7
Elsewhere	4
Total	21



Photograph 19: Burnt forest area on the fault escarpment on the southern slopes.



J. Landslides

In total, 181 landslides were spotted in the forests (Map 16). The majority of the landslides were located on the steep ridges emanating from the Kinangop peak on the eastern and south-eastern slopes. (Table 11).

Table 11: Landslides

Location	Number of landslides
Eastern and south-eastern slopes	159
Elsewhere	22
Total	181

Photograph 20: Landslide on the south-eastern slopes.



K. Quarries

Some 23 quarries were recorded in the Aberdare Range forests (Map 17). Most of them were located in Nyeri Forest Reserve and Kiganjo Forest Reserve on the eastern slopes and on the northern part of the Aberdare Forest Reserve (Table 12). All the quarries were outside fenced forest areas.

Table 12: Quarries

Location	Number of quarries
Kiganjo FR	5
Nyeri FR	10
Northern Aberdare	7
Elsewhere	1
Total	23



Photograph 21: Quarry in Kiganjo Forest Reserve.



VII. DISCUSSION OF THE RESULTS

A. Introduction

The forest destruction recorded during the survey fell under ten categories: logging of indigenous trees, charcoal production, cultivation of marijuana (*Cannabis sativa*), other cultivated fields in the indigenous forest, settled encroachments, shamba-system practices, livestock grazing, burnt forest areas, landslides and quarries. All categories of threats, apart from landslides, are directly human induced.

Each type of threat to the forest is discussed below. Ground data collected before the survey by Newton Wathai (KFWG) and Edward Coleridge (Rhino Ark) have been used in the discussion of the results. In addition, fencing as a conservation measure implemented in the Aberdares is reviewed.

B. Logging activities

Logging of indigenous trees

The magnitude of forest destruction through logging of indigenous trees is very high. Camphor trees were counted separately as they are among the most valued hardwood timber from East African mountains and were identified as heavily targeted during the two previous aerial surveys in Mt. Kenya (1999) and Mt. Kilimanjaro (2001). Camphor trees occur naturally only on the south-eastern slopes of the Aberdares, from Kigumo, north of the Chania River, to Magina to the south. Of 9,425 felled indigenous trees, only 272 were Camphors. They were mainly recorded deep inside the forest. Ground data revealed that past illegal exploitation had almost depleted the Camphor stand.

Cedar trees were also identified separately. Of the 9,425 felled indigenous trees, about 4,446 were Cedar trees, making Cedar the most targeted indigenous tree species in the Aberdares. The major felling activities were located in most forest areas where Cedar is a dominant tree species, in particular across the western slopes from Limuru to Nyahururu, in South Lakipia FR and on the eastern slopes north of the Salient.

On the western slopes, logging of Cedar and large scale charcoal production (see below) occur simultaneously. Their cumulative impacts have destroyed over 50 percent of the forest canopy in many places and much of the understorey. In the northern block of South Lakipia FR, extensive logging led to the destruction of the entire forest. In that area, trees are now only found on the private lands that surround the forest reserve.

Logging of indigenous trees has been banned since the 1986 Presidential Ban on the Exploitation of Indigenous Forests. Since that time, licences to harvest indigenous trees have been granted on an exceptional basis, but no such licenses have been issued recently in the Aberdares. All the nearly 10,000 recently logged trees recorded in the Aberdares are the result of illegal activities.

Logging in forest plantations

In addition to the logging in indigenous forests, the survey recorded 172 occurrences of tree felling in the forest plantations (Map 18). By regulation, a licence must be granted to harvest a forest plantation. However, in a letter dated 21st January 2003 by the Chief Conservator of Forests, it transpired that no licence has been granted for the Aberdare Range forest plantations. Consequently, the 172 occurrences of tree felling are irregular activities and most likely no payment was made to the Government for the harvested timber.

C. Charcoal production / burnt forest areas

Some 14,500 charcoal kilns were recorded in the Aberdare Range forests. Such an extremely high occurrence of charcoal production sites represents the largest single threat to the forests and is the main cause of destruction of the forest cover in many areas. Compared with the situation on Mt. Kenya in 1999 when the level of damage was deemed critically high, there were six times more kilns counted in the Aberdares, although the area is 30 percent smaller.

Charcoal production occurs across the entire ecosystem. Its intensity, however, varies geographically. In fenced forest areas on the eastern and northern slopes, charcoal production was very low. On the eastern side of the Kikuyu



Escarpment FR, it was most intense and led to total destruction of forest cover in most areas along the forest boundary and up to few kilometres deep inside the forest. Large scale charcoal production was also recorded all along the Sattima fault on the western slopes. Ground survey revealed that, in South Laikipia FR, Cedar and *Croton macrostachyus* are being used for charcoal due to depletion of *Dombeya torrida* and *Olea europaea*, two of the most preferred species. It also established that, in some areas, residents harvest trees from the forest reserves and produce charcoal on their farms to avoid arrest.

Charcoal production inside forest reserves is illegal in view of the extensive destruction of tree cover associated with traditional charcoal production methods, and also the fire risks it presents to the forest ecosystem. Seventeen of the 21 burnt forest areas were observed along the escarpment on the southern and northern slopes. They are likely caused by charcoal production which is rampant in these two areas, particularly on the southern slopes.

Poor enforcement and abuse of forest regulations by those in charge of their application are clearly major contributing factors, as well as the use of woodfuel to meet over 70 percent of domestic energy needs in Kenya. High fuel price and low levels of employment are worsening the situation by producing a high demand for charcoal and people willing to take the risk of engaging in an illegal activity. If these issues are not effectively addressed, charcoal production in the Aberdares as well as in many other forests will continue unabated. Data and information collected by KFWG revealed that charcoal production is the leading cause of degradation of forested ecosystems in many areas, such as Rumuruti, Eburru and Narok. A recent report on Mt. Kenya forests (Vanleeuwe, 2003) highlights that charcoal production, although reduced by over 60 percent, remains a persistent threat. Policy responses in the forestry and energy sectors are urgently required to prevent charcoal production from further devastating the forests of the Aberdare Range as well as many other forests.

D. Illegal cultivation

Cultivated fields in the indigenous forest

The numerous cultivated fields - 146 in total, mostly planted with tobacco and some with maize - occurring within the indigenous forest were mainly established in areas of mixed forest that would have been clear-felled for the purpose. Some fields also occurred in the bamboo zone. None of them was as a result of encroachment from Shamba-system areas but were remote and discreet, often clustered close together but obviously situated to avoid easy detection.

However, it is most unlikely that their presence was unknown to the authority responsible for managing the immediate area, particularly the 83 fields located on the eastern slopes near Chinga, some of which are visible from the forest boundary. The traffic of cultivators in and out of the forest with bags of harvest must be considerable and a widely known activity within the area.

Cultivation of marijuana

Only 16 small marijuana fields in various stages of cultivation were observed. They were spread fairly widely along the eastern slopes near Endarasha, Chinga and Wanjarere. The presence of these fields does not yet pose a serious threat to the ecosystem and, at the moment, is probably small-scale supply to the local user market. However, action should be best taken immediately to prevent further expansion, which could also occur as a result of anti-narcotic operations on nearby Mt. Kenya.

E. Settled encroachments and Shamba-system practices

Settlements have affected 6,181 hectares of Aberdare Range gazetted forests. They are associated with unprocedural settlement schemes and encroachments deriving from the Shamba-system. Some of the settlement schemes started way back in the 1960s and were established in natural forests without assessing the ecological implications.

In addition, squatters have invaded forestland in anticipation of being allocated the land. In Kieni forest, in the Kikuyu Escarpment FR, for example, over 3,500 families are claiming forestland for settlement.

If well implemented, the Shamba-system is an effective method for establishing forest plantations. However, abuse of the system has on several occasions prompted the government to ban it. Currently, there is no ban on the system.



In the Aberdares, abuse of the Shamba-system led to irregular settlements, encroachment into indigenous forest areas and backlogs in the establishment of plantations. Approximately 69 percent of the Shamba-system areas were not planted with trees. The failure of the system is mainly attributable to inadequate enforcement of law and regulations. For example, contrary to laid down regulations, farmers are allowed to cultivate the forest plots for long periods (often over 3 years), and to cultivate on hill tops. In some instances, permanent structures have been erected by farmers in Shamba-system areas, leading to permanent occupation of forest land. In addition, ground surveys undertaken by KFWG revealed that Shamba-system plots have been allocated against payment, resulting to claims of ownership of that land.

In four percent of the Shamba-system areas, cultivation has taken place beyond the boundaries of the forest plantations, encroaching into the indigenous forests. If left unchecked, such practices will contribute to the loss of significant stands of indigenous forest, impairing further the invaluable environmental services provided by the forest.

F. Livestock grazing

Extremely high numbers of livestock were recorded throughout the lower elevations of the Aberdare Range. Some 18,497 head were counted from the aircraft with many more remaining unseen in the forest. Although there is provision within the Forest Act for subsistence grazing (presumably not to the detriment of forest regeneration), these numbers imply uncontrolled access by opportunist farmers turned pastoralists.

Furthermore, the presence of such herds is in direct competition with an increasingly beleaguered wildlife population affected by this and other human-induced activities. Small wonder that wildlife is constantly seeking to flee the area through ancient migratory routes, long since sealed off by settlement.

G. Landslides and quarries

Some 181 landslides were recorded. The majority of the landslides were located on the eastern and south-eastern slopes. Among them some 60 landslides were found on the steep ridges emanating from Kinangop peak that are mostly covered by bamboo with no visible human activities. These landslides were most likely caused by the combination of two factors: high rainfall and steep slopes. Further south in the *Ocotea* forest in the Kikuyu Escarpment FR, some 55 landslides were observed. Being one of the areas most impacted by illegal human activities, in particular logging and charcoal production, this suggests a possible correlation between these activities and the high occurrence of landslides.

Twenty-three quarries were observed in the Aberdares, most of them in Nyeri FR, on the north-eastern slopes of the Aberdare FR and in Kiganjo FR. Existence of these quarries in forest reserves is not compatible with forest conservation and management. They have contributed to loss of indigenous forest vegetation and removal of soil, hence undermining future prospects for natural regeneration.

H. Conservation measures and fencing

Electrified fencing is a management tool which has proved effective in Southern and Eastern Africa to control movement of wildlife, manage access - through agreed protocols - of people into protected areas and to reduce illegal, uncontrolled removal of (or damage to) protected area products and natural resources. It can be among the most suitable solutions in areas where wildlife and high density farming communities are learning to live side by side. However, the effectiveness of a fence in controlling either wildlife or people depends on a number of factors, including: location, community acceptance, maintenance and manning.

In the Aberdares, the 160 kilometres of fence has succeeded in keeping some illegal activities at a very low level, in particular charcoal production. Logging of Cedar trees still remains a persistent threat inside the fence, as well as livestock grazing, although their occurrence is less than in neighbouring unfenced forest. The ground survey established that people gain access to fenced forest through unmanned gates, by digging trenches underneath the fence and by short-circuiting the electric fence. Cultivation of crops, including tobacco and marijuana, is still high inside the fenced area. Cultivation of tobacco was occurring before the fence was erected. Monitoring and enforcement measures would be required to stop these activities that have been carried out for a long while.



VIII. CONCLUSIONS / RECOMMENDATIONS

The forests of the Aberdare Range are being devastated by large-scale uncontrolled, irregular or illegal human activities, in particular charcoal production, logging of indigenous trees, encroachment and settlements, cultivation of marijuana and other crops, and livestock grazing. The ongoing assault on these forests poses grave threat to Kenya's water security, biodiversity conservation and economic development.

In 1999, Mt. Kenya forests were selected for the first aerial survey of its kind as Mt. Kenya was perceived "to stand out prominently to illustrate the degradation wrought upon these valuable natural resources". The present situation in the Aberdares clearly shows that forest destruction on Mt. Kenya was not an exception; indeed, it can be even more critical in other forest ecosystems.

Prompt and effective policy responses are required to prevent further devastation of the Aberdare Range forests; its integrity is already in great jeopardy. These responses should take fully into account successes experienced in forest conservation, in particular those related to the protection measures put in place on Mt. Kenya since 2000, as well as the partial fencing of the Aberdares. The following measures are, therefore, recommended:

Short-term measures

- 1) The management of all indigenous forests in the Aberdares should be revised immediately to effectively address illegal activities, in particular charcoal production and logging of indigenous trees. In this process, the successful implementation of protection measures on Mt. Kenya could serve as an example.
- 2) The transit of illegal forest produce, in particular charcoal and timber, should be brought under control through coordinated actions by all Government arms.
- 3) The fencing of the forest should continue in order to prevent human-wildlife conflict and protect indigenous forests from illegal activities. Future fence alignment should follow the existing gazetted forest boundary. Kipipiri hill should be included in the fencing of the Aberdares.
- 4) Existing Government settlement schemes in the forest reserves should be surveyed and formalized. Squatters within the forest reserves should be resettled outside gazetted forests.

Medium-term measures

- 1) Alternative sources of domestic energy should be identified and promoted through the use of economic incentives, among others.
- 2) A review of the forest plantations should be undertaken. Any areas that are assessed unsuitable for plantations or where forestry management is not functional should revert to natural forest, in line with the Government policy to increase natural forest cover.
- 3) All stakeholders should actively seek commitment from decision-makers to implement the stated policy of increased natural forest cover and protection of biodiversity and water catchments.
- 4) All stakeholders who benefit from the Aberdare Range forests, including the energy and water sectors, should contribute directly to its conservation in proportion to the benefits derived.
- 5) The Government should consider nominating the Aberdare Range as a UNESCO World Natural Heritage Site.

Long-term measures

- 1) Forest areas destroyed should be rehabilitated.
- 2) An integrated management plan for the Aberdare Range should be developed in consultation with all main stakeholders, taking into account traditional subsistence uses.
- 3) An energy strategy should be elaborated that supports the development of, and access to, energy sources that have minimum environmental impacts.
- 4) A land use policy should be developed to induce land use planning that takes fully into account environmental constraints and opportunities in particular water catchment values, elephant corridors and soil susceptibility to erosion.



ABBREVIATIONS

DEWA:	Division of Early Warning and Assessment
FD:	Forest Department
FR:	Forest Reserve
GIS:	Geographical Information System
GPS:	Global Positioning System
KFWG:	Kenya Forests Working Group
KIFCON:	Kenya Indigenous Forest Conservation Programme
KWS:	Kenya Wildlife Service
RSO:	Rear seat observer
UNDP:	United Nations Development Programme
UNEP:	United Nations Environment Programme
UNESCO:	United Nations Educational, Scientific and Cultural Organization

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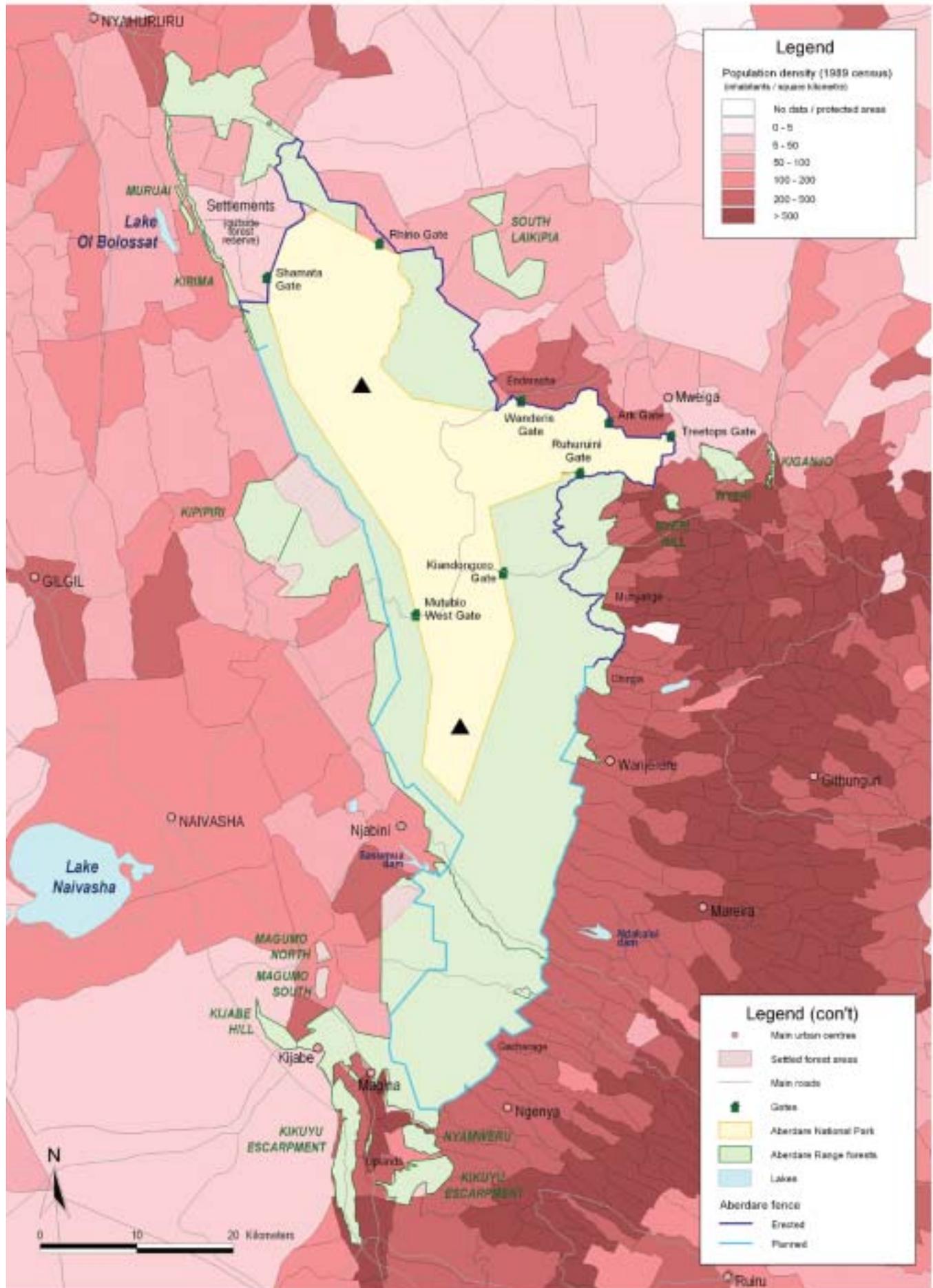


ANNEX: MAPS 1 TO 18

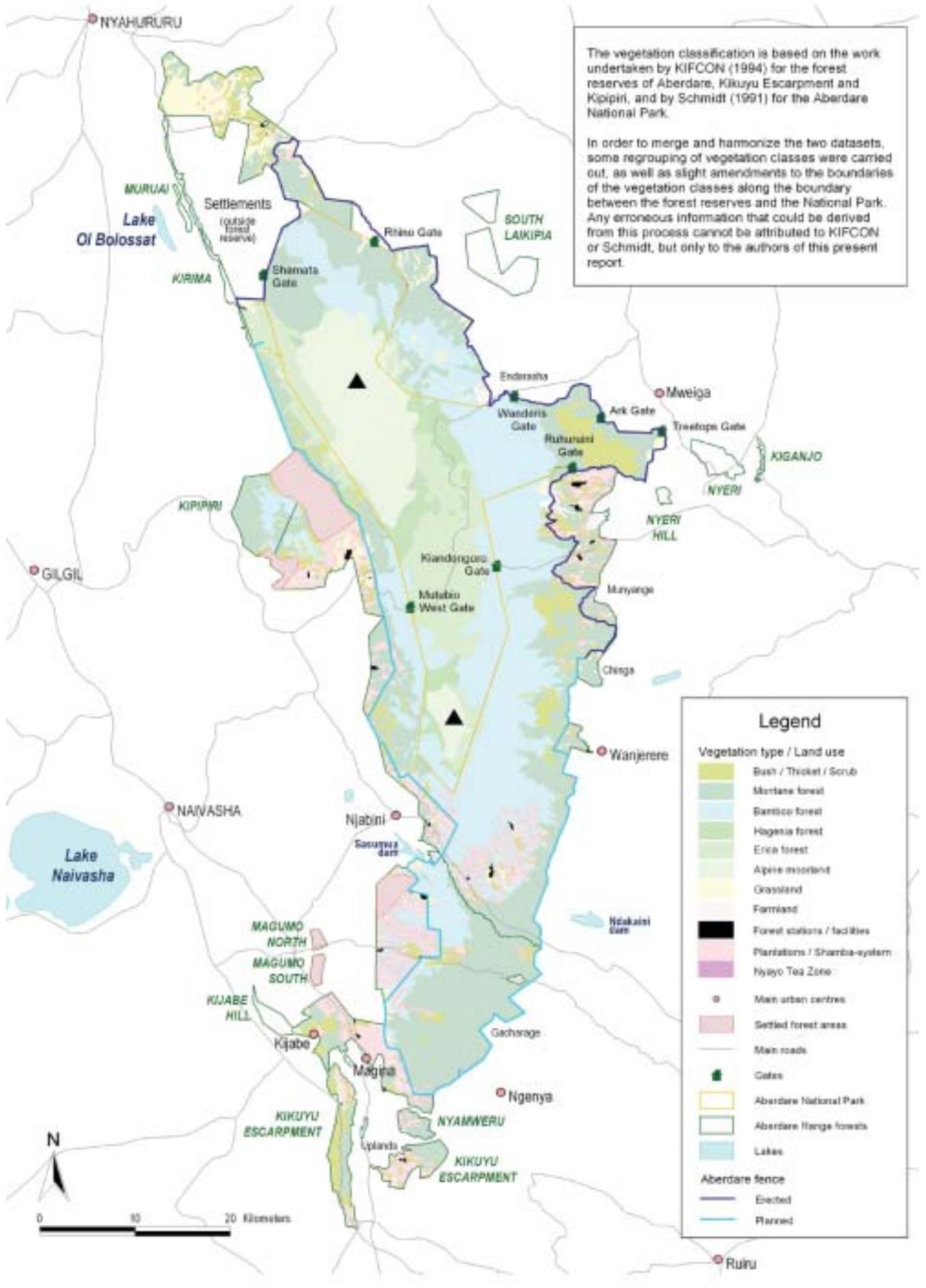
- Map 1:** Population pressure
- Map 2:** Vegetation types
- Map 3:** Survey blocks
- Map 4:** Flight lines
- Map 5:** Overall threats to the forests
- Map 6:** Logging of Camphor
- Map 7:** Logging of Cedar
- Map 8:** Logging of other indigenous trees
- Map 9:** Charcoal production
- Map 10:** Cultivation of marijuana
- Map 11:** Cultivated fields in the indigenous forest
- Map 12:** Settled encroachments
- Map 13:** Shamba-system practices
- Map 14:** Livestock grazing
- Map 15:** Burnt forest areas
- Map 16:** Landslides
- Map 17:** Quarries
- Map 18:** Logging in forest plantations



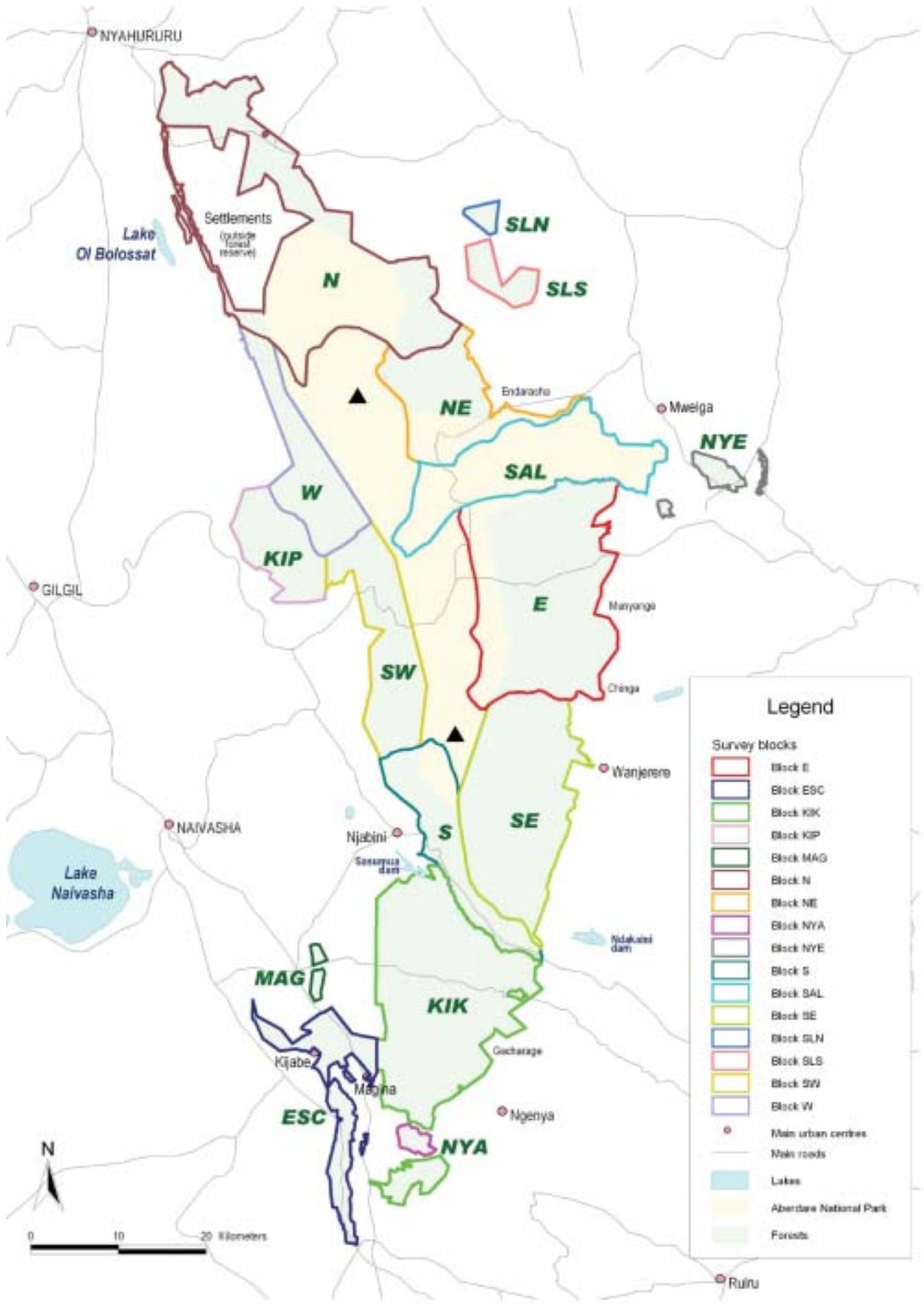
Map 1: Population pressure



Map 2: Vegetation types



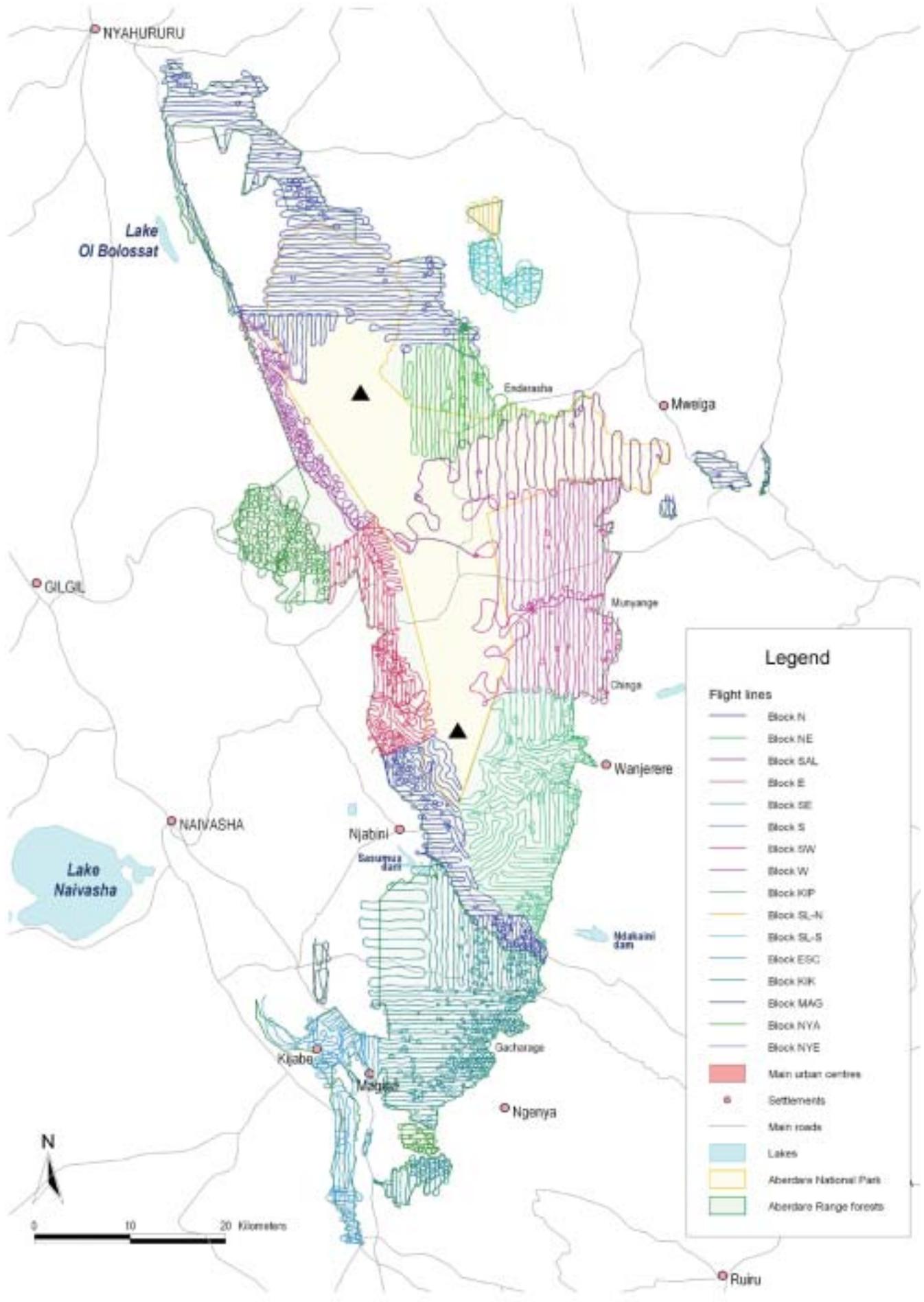
Map 3: Survey blocks



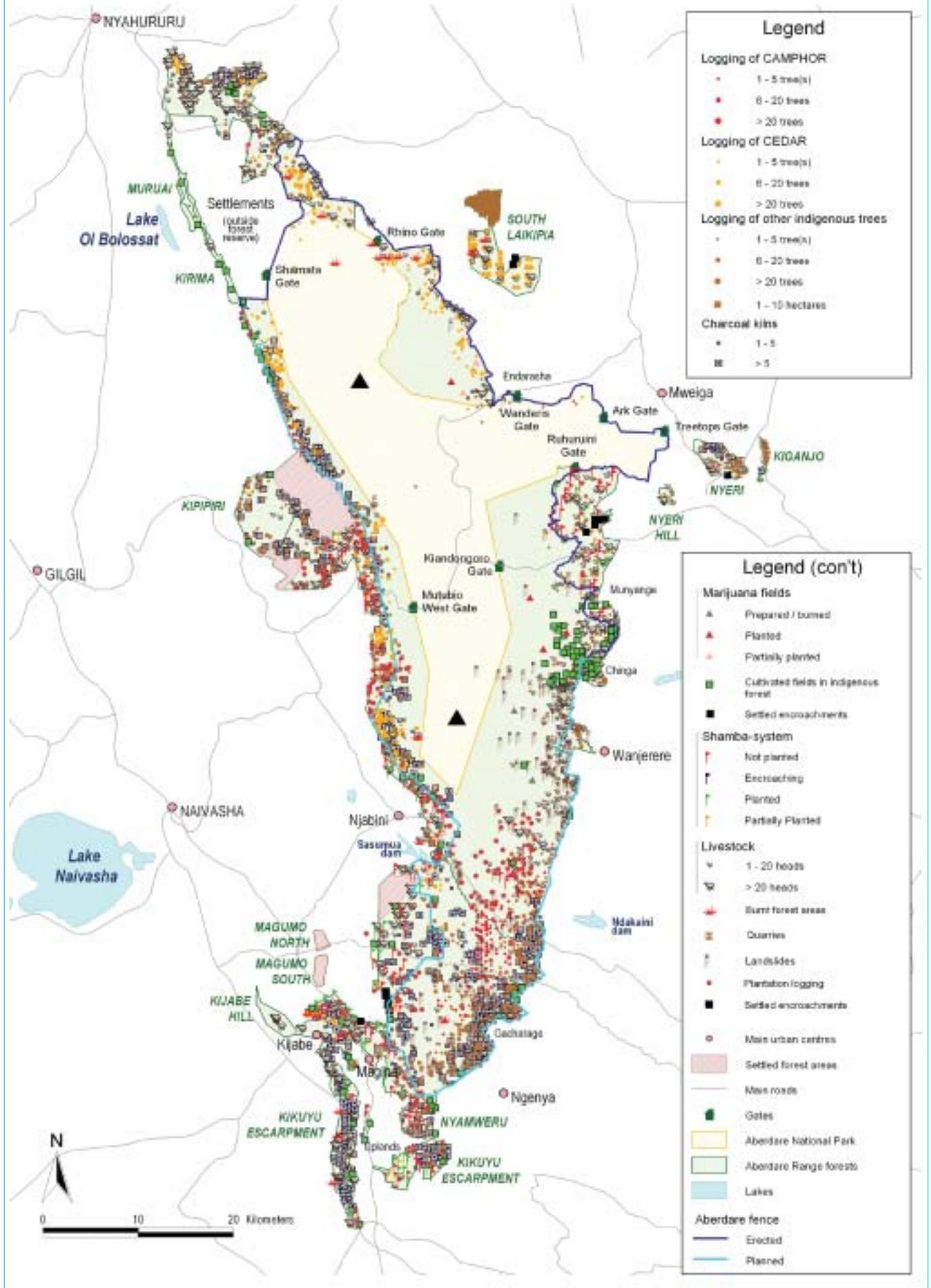
Legend

Survey blocks	
[Red box]	Block E
[Blue box]	Block ESC
[Green box]	Block KIK
[Pink box]	Block KIP
[Light green box]	Block MAG
[Yellow box]	Block N
[Orange box]	Block NE
[Purple box]	Block NYA
[Grey box]	Block NYE
[Teal box]	Block S
[Light blue box]	Block SAL
[Yellow-green box]	Block SE
[Blue box]	Block SLN
[Red box]	Block SLS
[Yellow box]	Block SW
[Purple box]	Block W
[Red dot]	Main urban centres
[Grey line]	Main roads
[Blue area]	Lakes
[Yellow area]	Aberdare National Park
[Light green area]	Forests

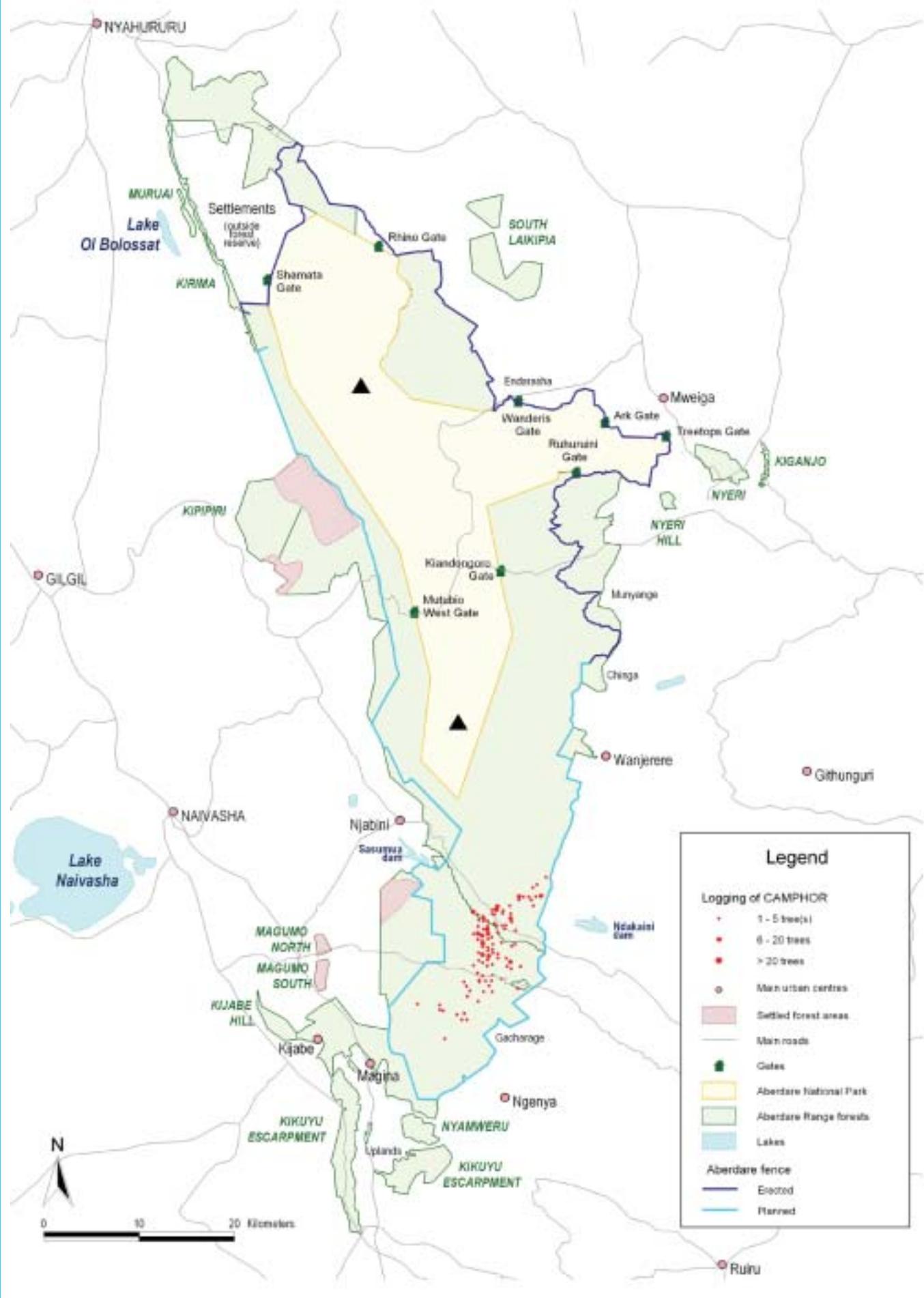
Map 4: Flight lines



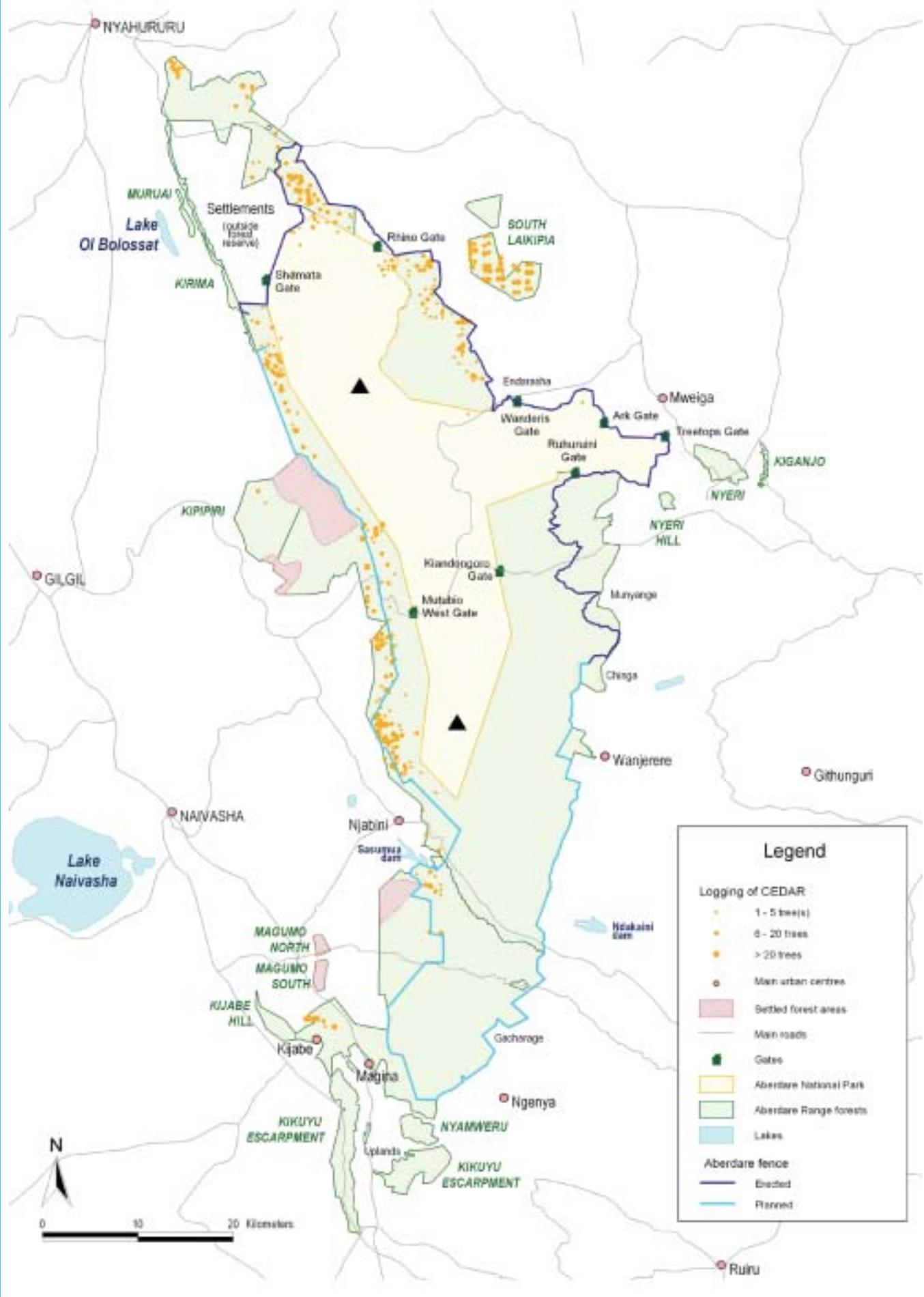
Map 5: Overall threats to the forests



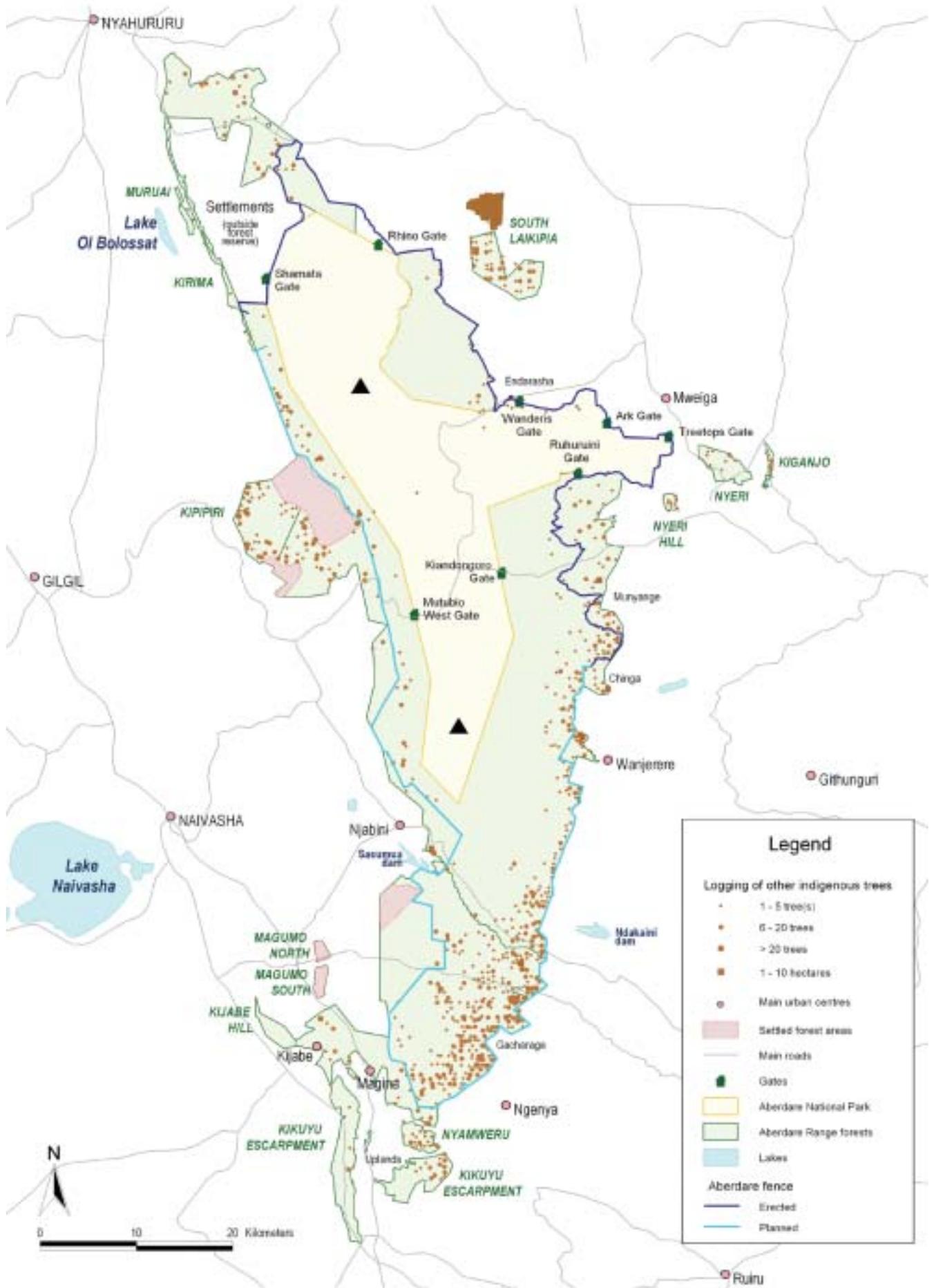
Map 6: Logging of Camphor



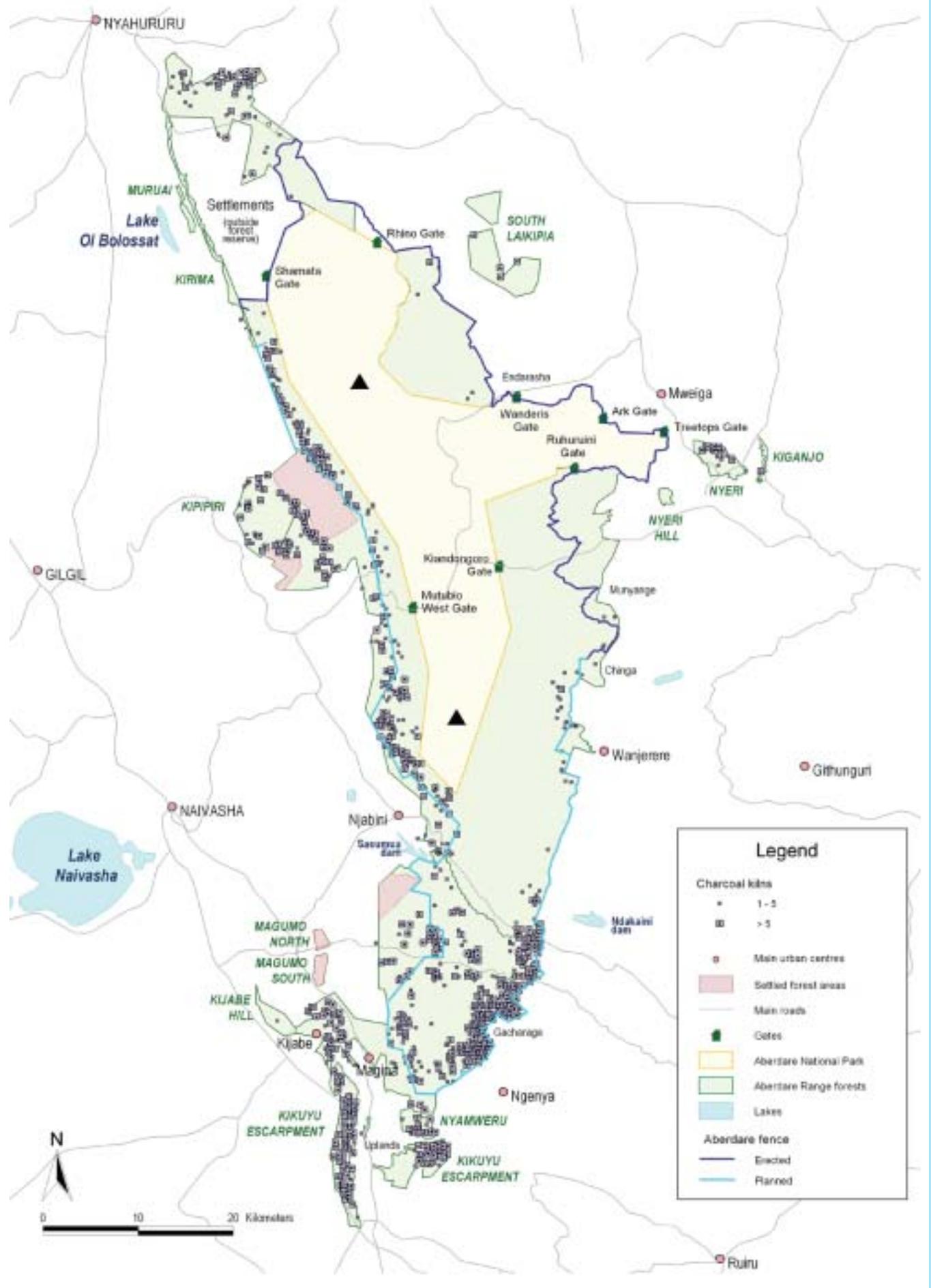
Map 7: Logging of Cedar



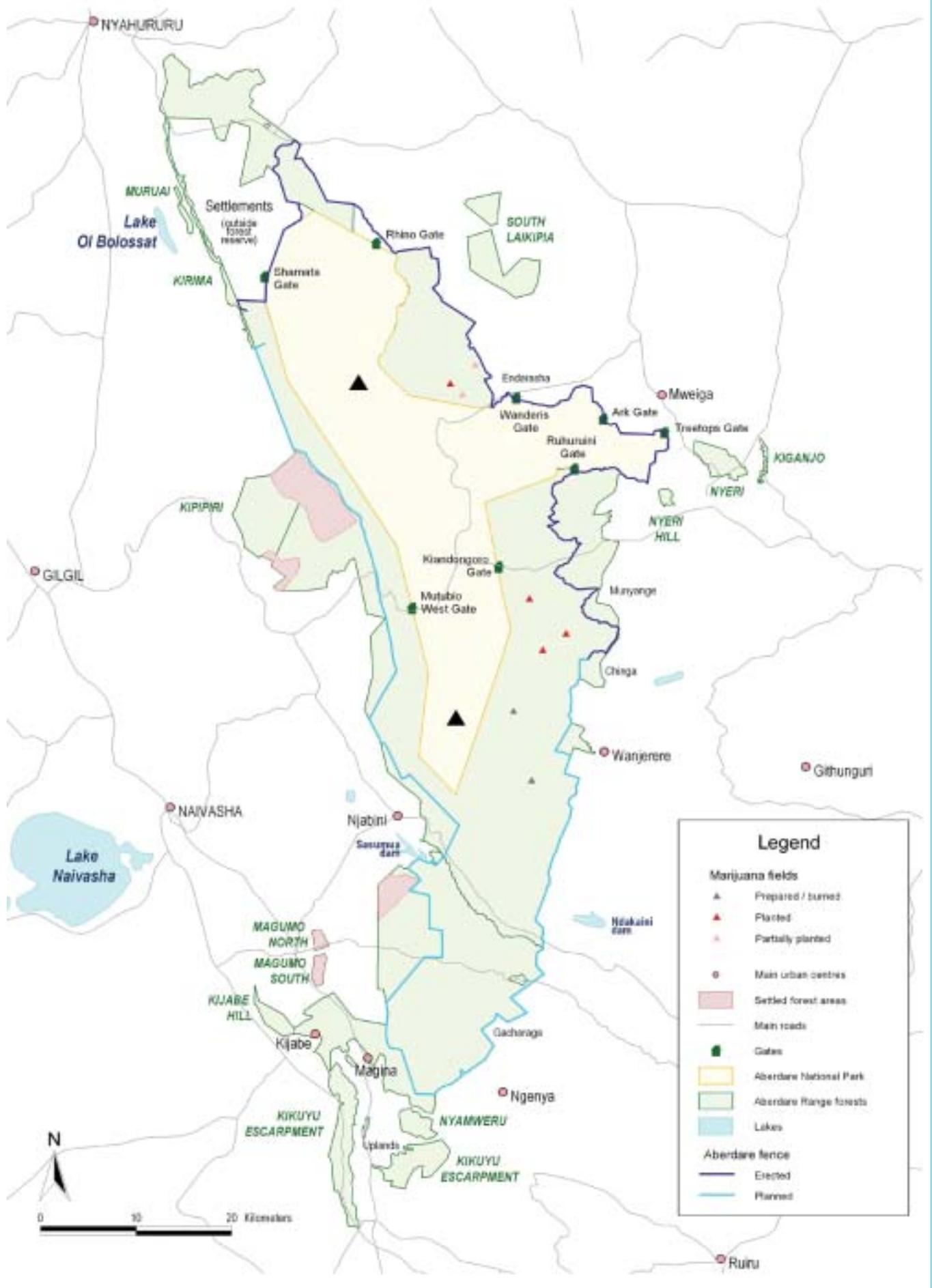
Map 8: Logging of other indigenous trees



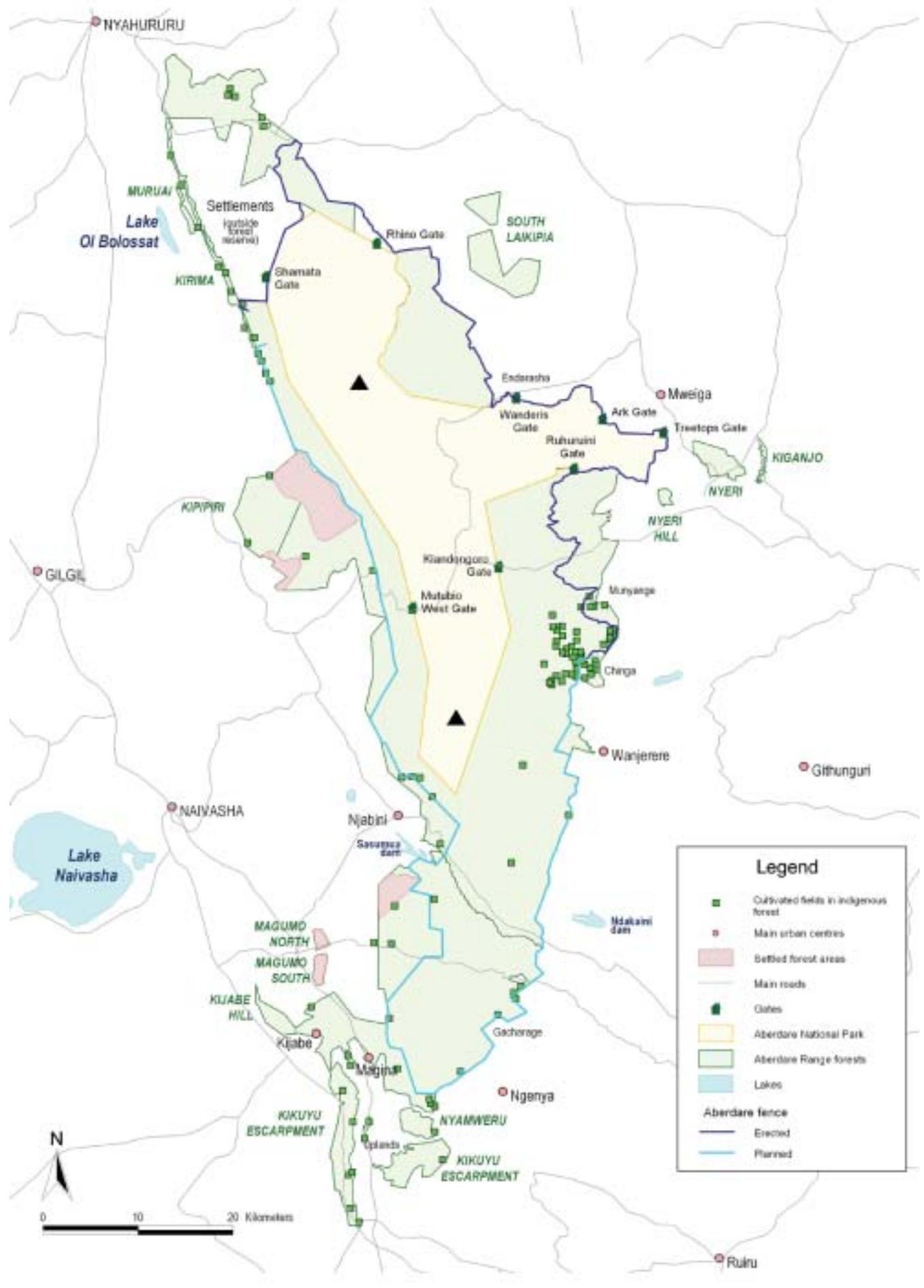
Map 9: Charcoal production



Map 10: Cultivation of marijuana

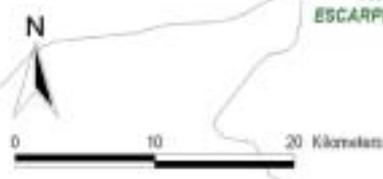


Map 11: Cultivated fields in the indigenous forest

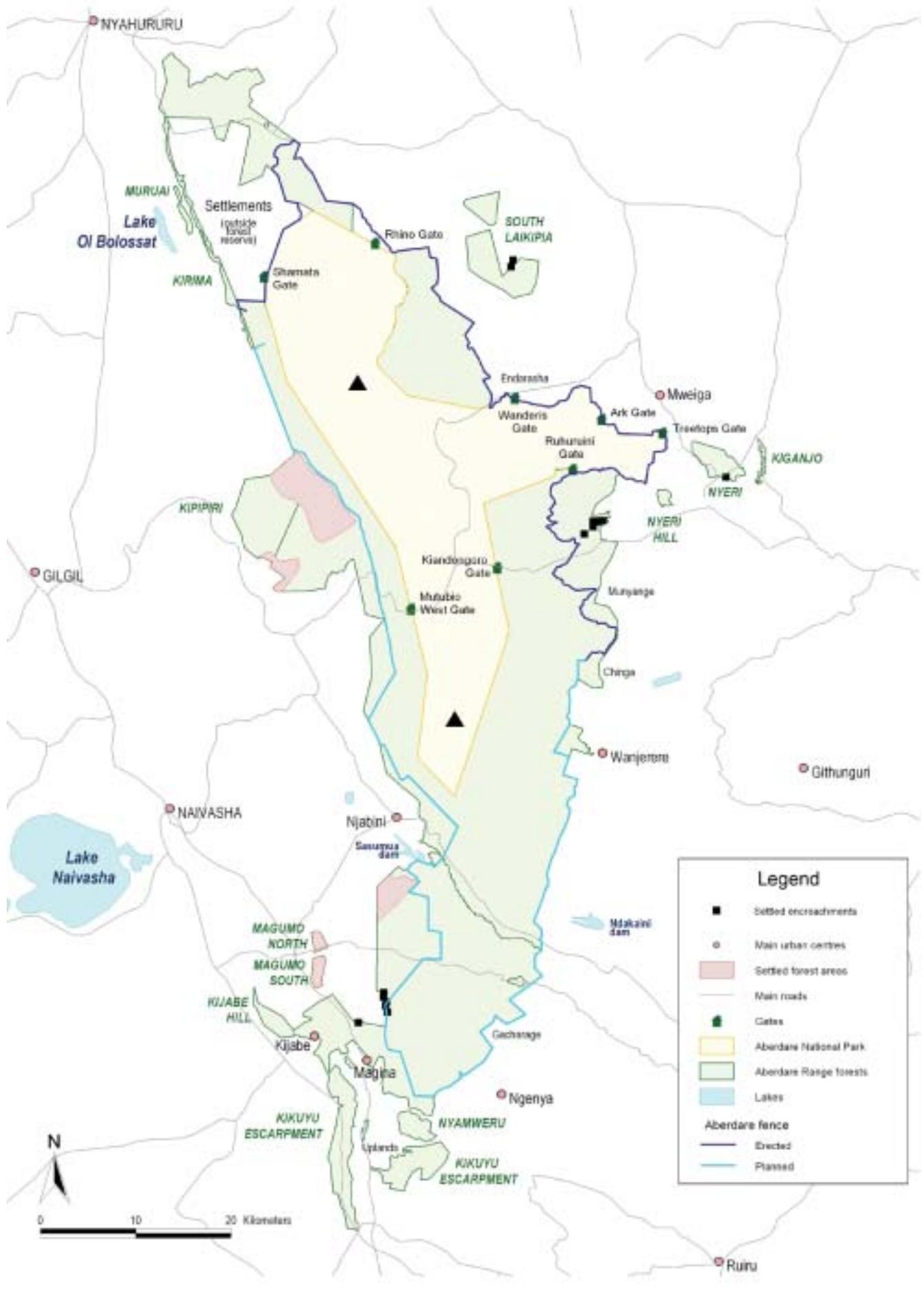


Legend

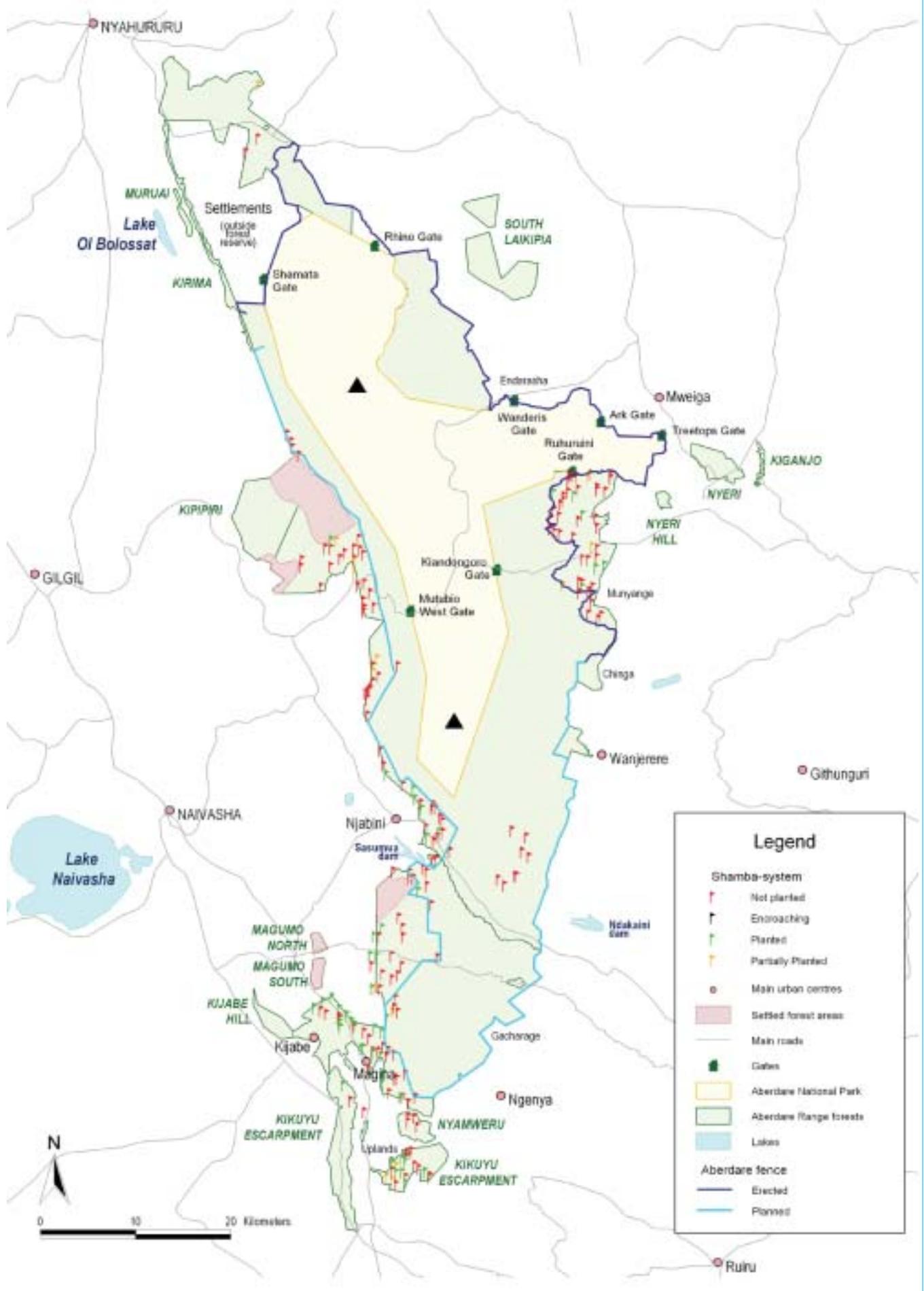
- Cultivated fields in indigenous forest
- Main urban centres
- Settled forest areas
- Main roads
- Gates
- Aberdare National Park
- Aberdare Range forests
- Lakes
- Aberdare fence**
 - Erected
 - Planned



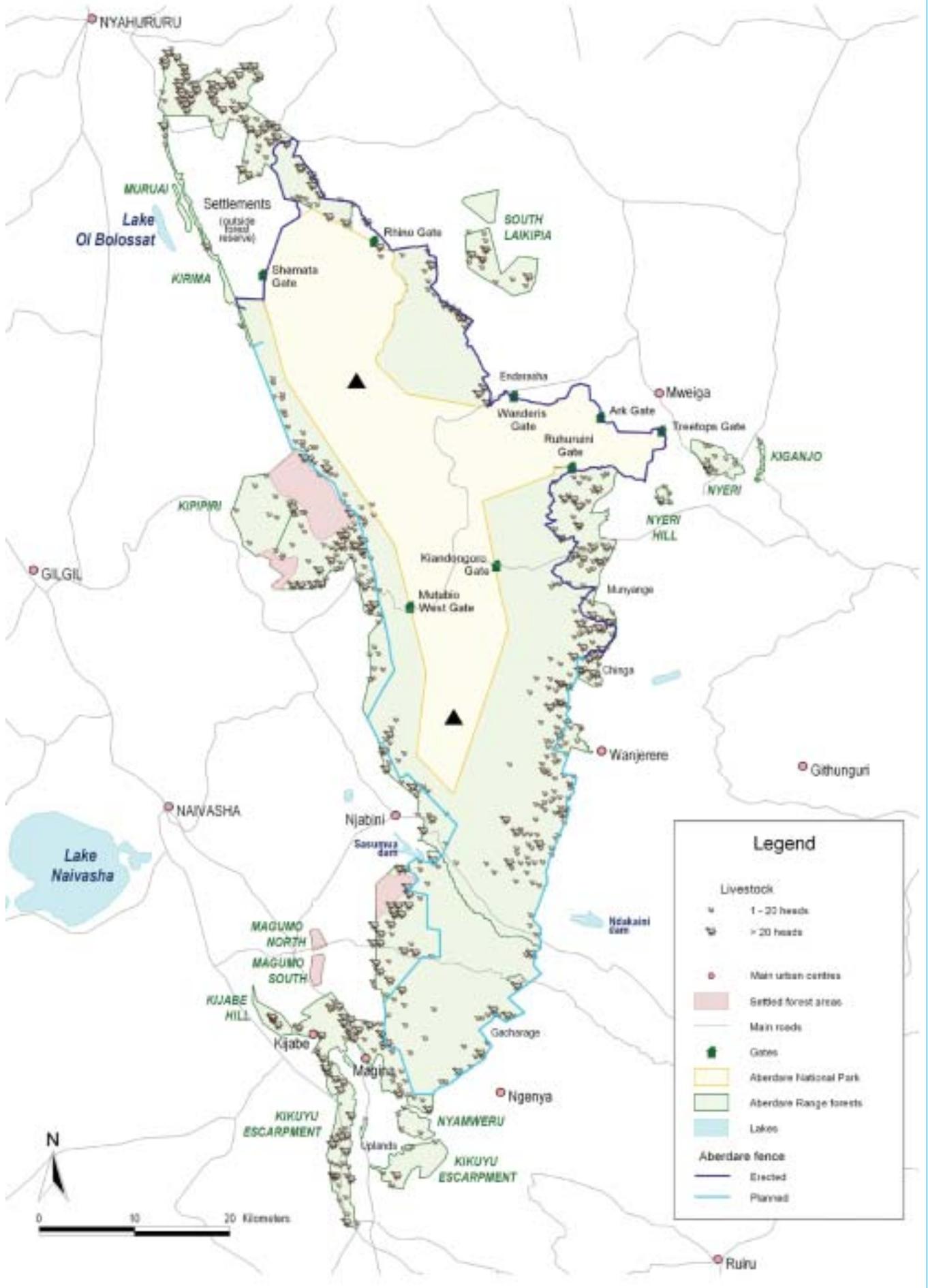
Map 12: Settled encroachments



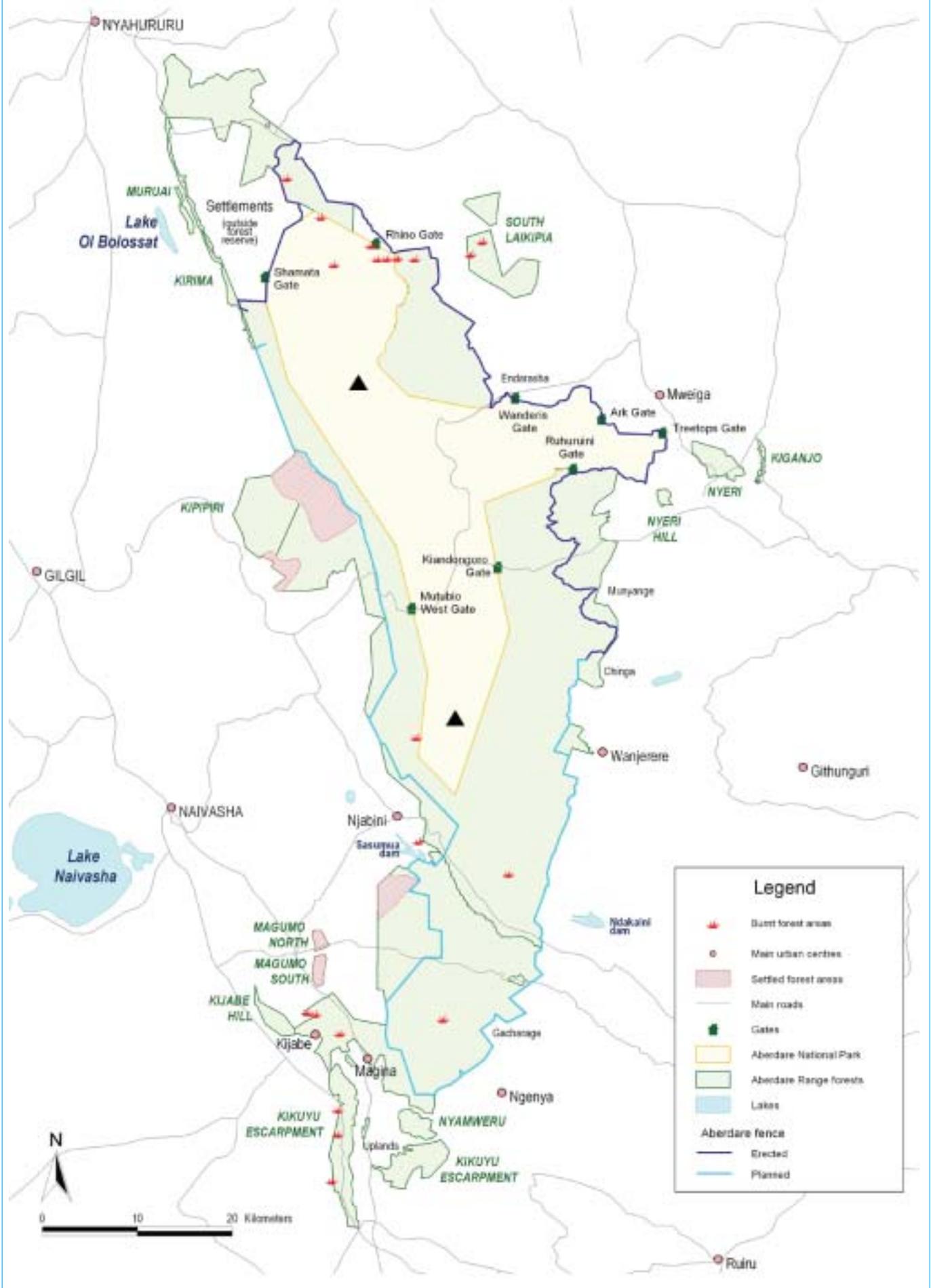
Map 13. Shamba-system practices



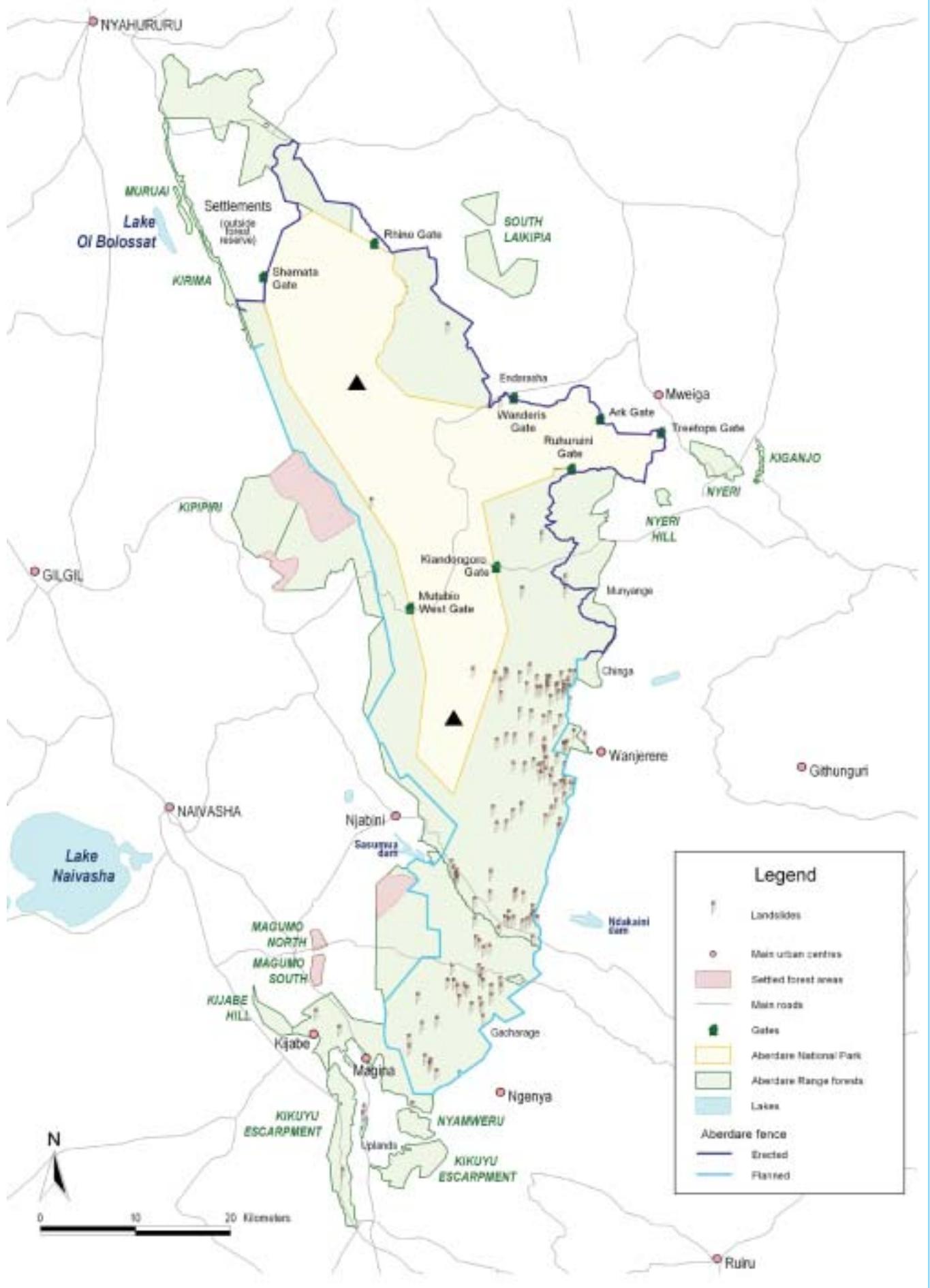
Map 14: Livestock grazing



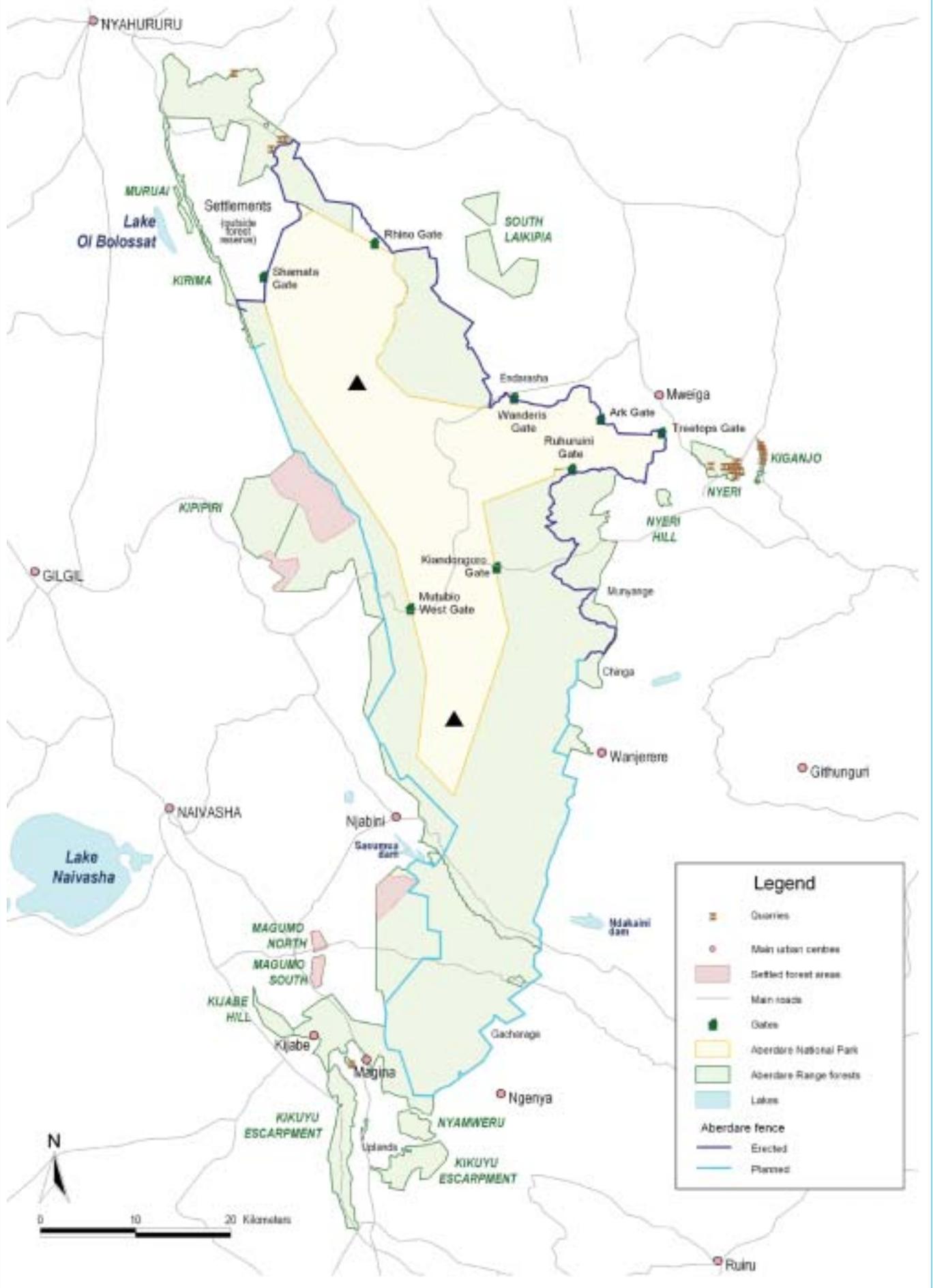
Map 15: Burnt forest areas



Map 16: Landslides



Map 17: Quarries



Map 18: Logging in forest plantations

