

**A REPORT FOR THE KENYA WILDLIFE SERVICE
AND THE KENYA FOREST DEPARTMENT**

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**ABERDARES NATIONAL PARK AND ABERDARES
FOREST RESERVES WILDLIFE FENCE PLACEMENT
STUDY AND RECOMMENDATIONS**



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Copies of a draft of this report were provided to the Kenya Wildlife Service, Forest Department and Rhino Ark in early July, 1999, for review. The corrections, suggestions and comments of the reviewers were received in October, 1999, and have been incorporated into this final report.

The views expressed in this report are those of the author. They do not necessarily reflect the views of the Kenya Wildlife Service, Kenya Forest Department or Zoo Atlanta

Cover: Mountain bongo Boocercus eurycerus isaaci. This subspecies is both endemic to Kenya and symbolic of the Aberdares Range. Drawing by Jonathan Kingdon. Drawing taken from Kingdon (1997) with permission of the artist.

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EXECUTIVE SUMMARY

In most places in Kenya, natural forests within protected areas are adjacent to lands with a high human population density and intensive cultivation. Conservation buffer zones are either completely absent or small and poorly developed. As such, there is often some level of damage by wildlife to crops, livestock, farm infrastructure, tree plantations and people.

Given these circumstances, if substantial wildlife populations are to continue to exist in Kenya's natural forests, the Kenya Wildlife Service (KWS) and Kenya Forest Department seem to have no option but to erect electric fences between local communities and protected areas. The main objective of these wildlife fences are 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 can be made sustainable.

One of the main activities at this time for the conservation of the Aberdares ecosystem (ca. 2,185 km²) is the construction of an electric fence around part or all of the Area. The ultimate objective of the wildlife fence is to establish a long-term win-win situation whereby (1) the conservation values of the Aberdares 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 in and near the Aberdares.

The main outputs of this study are:

- A plan for fencing of the remainder of the Aberdares Conservation Area, including fence placement and priorities of construction.
- An impact assessment of the proposed fencing plan.
- A multidisciplinary database for the wildlife fence, including baseline data for the monitoring of the impacts of the fence.
- A model for the collection of information on fence placement, fence impact, and fence monitoring, and for the presentation of the information in report form.

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

The question of whether game moats might be an alternative to electric fencing around parts of the Aberdares is examined. The conclusion of this study is that moats should not be used as they are expensive to construct and maintain, they are greatly affected by terrain and soil moisture and, most importantly, they are not capable of controlling the movement of people and livestock into protected areas.

The positive and negative impacts of an electric fence around most or all of the Aberdares Conservation Area were assessed. This study concludes that an electric fence would, overall, be very positive for the conservation of the Aberdares. Without the fence, the conservation values of the Aberdares will undoubtedly continue to erode, negatively affecting the well-being of millions of Kenyans and the biodiversity of the Nation. This study recommends measures to mitigate against the negative effects of the fence, and suggests a number of activities that would increase the effectiveness of the fence while reducing pressures from the local communities on the resources of the Aberdares.

This report gives details on the placement of the fence and access gates for each of the eight phases of the wildlife fence. The positive and negative impacts of each phase of the wildlife fence are then discussed and recommendations made for specific mitigation measures.

Finally, recommendations are made for monitoring the impact of the fence both on the natural environment and upon the local people. This is followed by sets of baseline data for monitoring change in the local human communities, and on tree, bird and large mammal communities within the Aberdares Conservation Area.

The study recommends the construction of a 312 km long electric fence. If the fence is placed as recommended, ca. 1,643 km² (88%) of the natural vegetation of the Aberdares Conservation Area will lie within the fence, while roughly 324 km² (73%) of plantation/encroachment will lie outside of the fence. All of the Aberdares National Park (ca. 774 km²), ca. 958 km² (68%) of the three forests reserves of the Aberdares, and 350 km² (88%) of the species-rich "wetter evergreen forest" would be protected by the fence. This placement of the fence takes into full consideration the many

guide-lines and constraints, and is judged suitable for the long-term conservation of the Aberdares.

In terms of scope and detail, this study is the first of its kind conducted for a wildlife fencing project in Kenya. KWS plans to use the approach taken in this study, and this report, as models for the compilation and presentation of information for similar fencing projects.

1. INTRODUCTION

In most places in Kenya, natural forests within protected areas are adjacent to areas with a high human population density and intensive agriculture. This means that there is often 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. As such, there is usually some level of damage by wildlife to crops, livestock, farm infrastructure, and tree plantations. Occasionally wild animals, such as elephants, buffaloes and lions, injure or kill people. This damage frequently has severe negative impact 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 Kenya Forest Department seem to have no option but to erect barriers between local communities and the protected areas (DHVC, 1992). The objective of erecting barriers is generally 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.

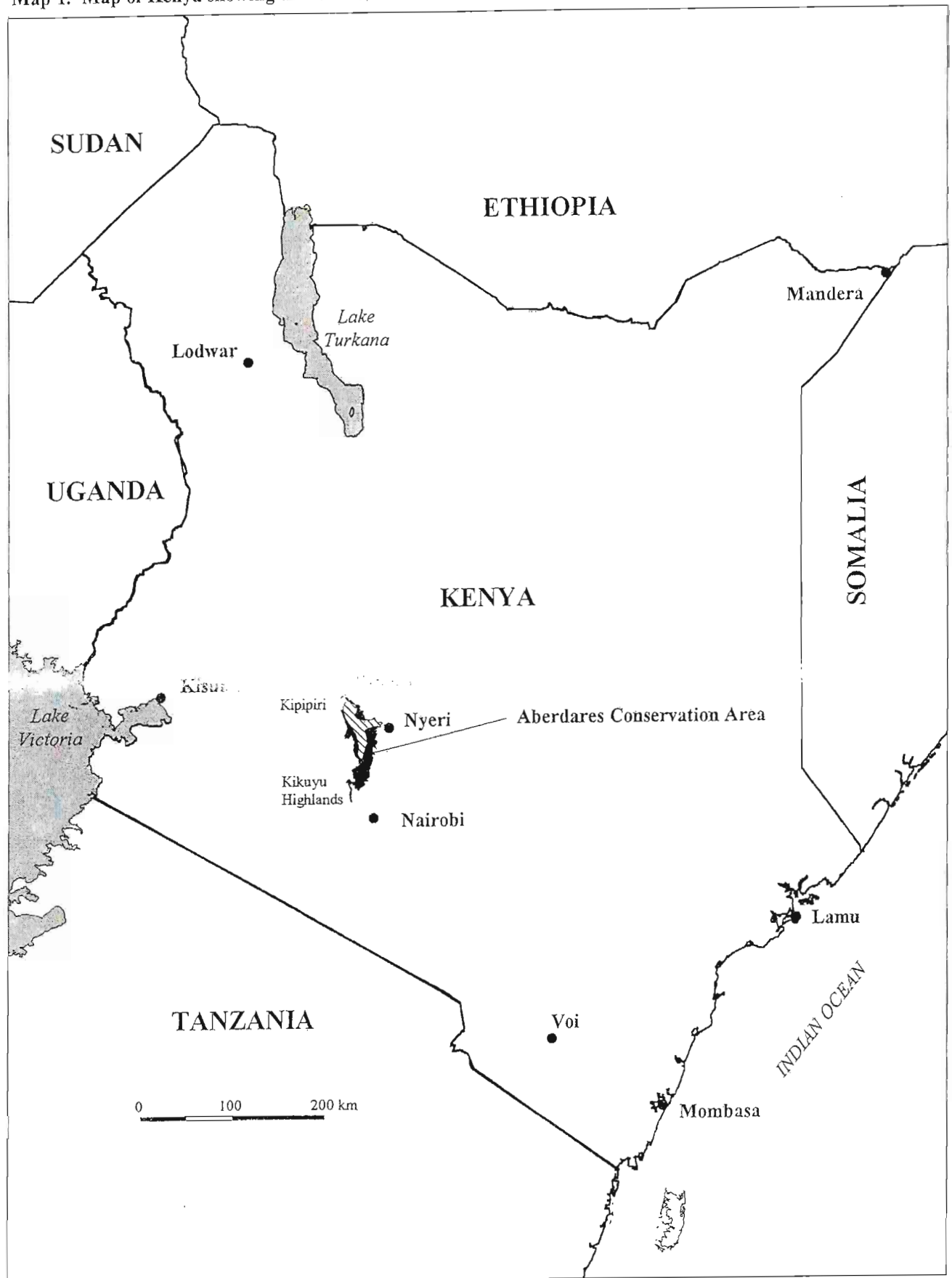
Upon completion of their review of wildlife barriers, DHVC (1992) concluded that "...community attitudes and opinions clearly demonstrated the low tolerance levels of rural communities towards wildlife in general, but communities were more supportive where effective barriers had been erected. Most communities 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, animal removal, etc., have been 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 either due to a lack of maintenance, inadequate funding, or for some other reason.

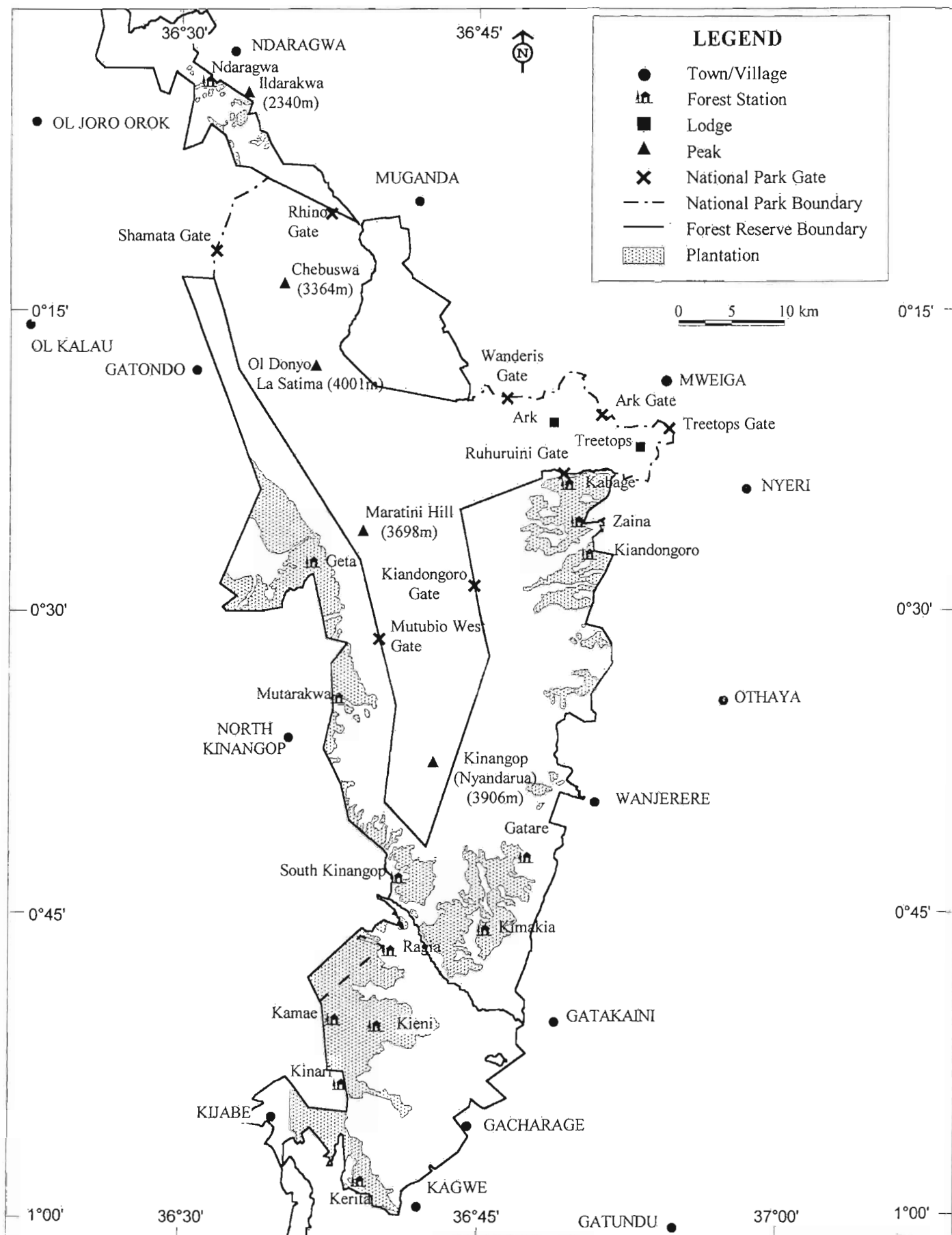
One of the policies of KWS is to protect people and property from injury or damage from wildlife (KWS, 1990). As such, KWS strives to reduce the level of human-wildlife conflict in areas where conflict is greatest, and particular where the protected area (national park or reserve) has high conservation values. One such area is the Aberdares Range (i.e., Aberdares Conservation Area).

One of the major activities at this time for the conservation of what remains of the natural ecosystem of the Aberdares is the construction of a barrier around part or all of the Aberdares Conservation Area (KIFCON, 1992; FAO, 1994) (Maps 1 & 2). The proximate objectives of this barrier are to (1) protect adjacent agricultural crops, forest plantations, livestock and people from damage by wildlife, and to (2) help KWS and Forest Department regain control of, and effectively manage, the exploitation of the natural resources of the Aberdares Conservation Area, thereby allowing for long-term, sustainable use. The ultimate objective (and challenge) of this effort is to create a long-term win-win situation whereby (1) the conservation values of the Aberdares Conservation Area 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 objective can be achieved, the big winners will be the people of Kenya, particularly those living in and near the Aberdares Conservation Area.

Map 1. Map of Kenya showing the location of the Aberdares Conservation Area.



Map 2. Aberdares Conservation Area, Kenya.



2. THE STUDY AND ITS OUTPUTS

2.1 MAIN ASPECTS OF THE STUDY:

- Assess the optimum placement of an electric fence for the Aberdares Conservation Area, with provisions for access to the Area.
- Assess likely impacts of fencing on populations of wildlife, and recommend mitigating actions.
- Predict likely impacts by compressed wildlife populations on the natural forest.
- Assess the feasibility of protecting existing and future commercial tree plantations from damage by wildlife, taking into consideration economic feasibility and management implications of alternative fence placements (including control of future human encroachment and fence maintenance).
- Assess local community aspects of fencing, including current levels of wildlife damage, attitudes to the existing and proposed fence, use of resources in the protected area, requirements for access to the protected area, opinions on proposed placement, and the role of the local community in the planning, construction and maintenance of the fence.
- Assess all proposed excisions and illegal encroachment.
- Assess implications of fencing for management of the Aberdares Conservation Area.
- Verify that fencing is the best option for reducing human-wildlife conflict and for attaining sustainable use of the Aberdares Conservation Area.
- Assess the physical suitability of the terrain for fencing in those sections where it is deemed necessary.
- Synthesis all of the above information and prepare a plan for the remainder of the fencing programme, including recommendations for priority phasing and optimal placement of the fence, and assess impacts of the fence.
- Make recommendations for implementation concerning boundary surveys, further local consultation, and demarcation of proposed fence placement.
- Recommend a monitoring programme to assess impacts of the fencing project, using data obtained during this study as a baseline.

2.2 MAIN OUTPUTS OF THE STUDY:

- A plan for fencing of the remainder of the Aberdare Conservation Area, including fence placement priorities and timing of construction.
- An impact assessment of the proposed plan.
- A multidisciplinary database for the fence, including baseline data for the monitoring of the impacts of the fence.
- Develop a model for the collection and presentation of information on fence placement, fence impact, and fence monitoring, and for the presentation of this information in report form.

2.3 THIS STUDY AND THE MANAGEMENT PLAN FOR THE "ABERDARES NATURAL RESOURCES DEVELOPMENT PROJECT"

The Aberdare Wildlife Fence Placement Study was undertaken not only to provide recommendations to the on-going construction of the wildlife fence but also to compile existing information and provide new data in preparation of the "Aberdare Natural Resources Development Project" (ANRDP). The ANRDP is an ambitious development and conservation initiative for the Aberdare Conservation Area and for the adjacent communities. The first major activity of the ANRDP will be the writing of a management plan for the project and for the project area. In preparation of the management plan, the Aberdare ecosystem will be zoned to facilitate data collection. Data will then be collected over the project area. This will include an inventory of the plants and animals, and a detailed socio-economic survey of adjacent communities. These data will be used for the planning of the ANRDP and as a baseline for assessing the impacts of the project (FAO, 1994). The objectives of the management plan are to harmonize all activities within the Aberdare Conservation Area and to guide project implementation.

This report provides considerable new data on the Aberdare Conservation Area and on adjacent communities. It also provides a fairly detailed review of the literature concerned with the biological environment of the Aberdare. As such, this report should considerably facilitate the development and writing of the management plan.

2.4 RESEARCH EFFORT

A team of five researchers spend about 500 man-days in the field working on this survey in and around the Aberdare Conservation

Area. The research team worked out of 16 camps during this study (Map 3). The following work was undertaken:

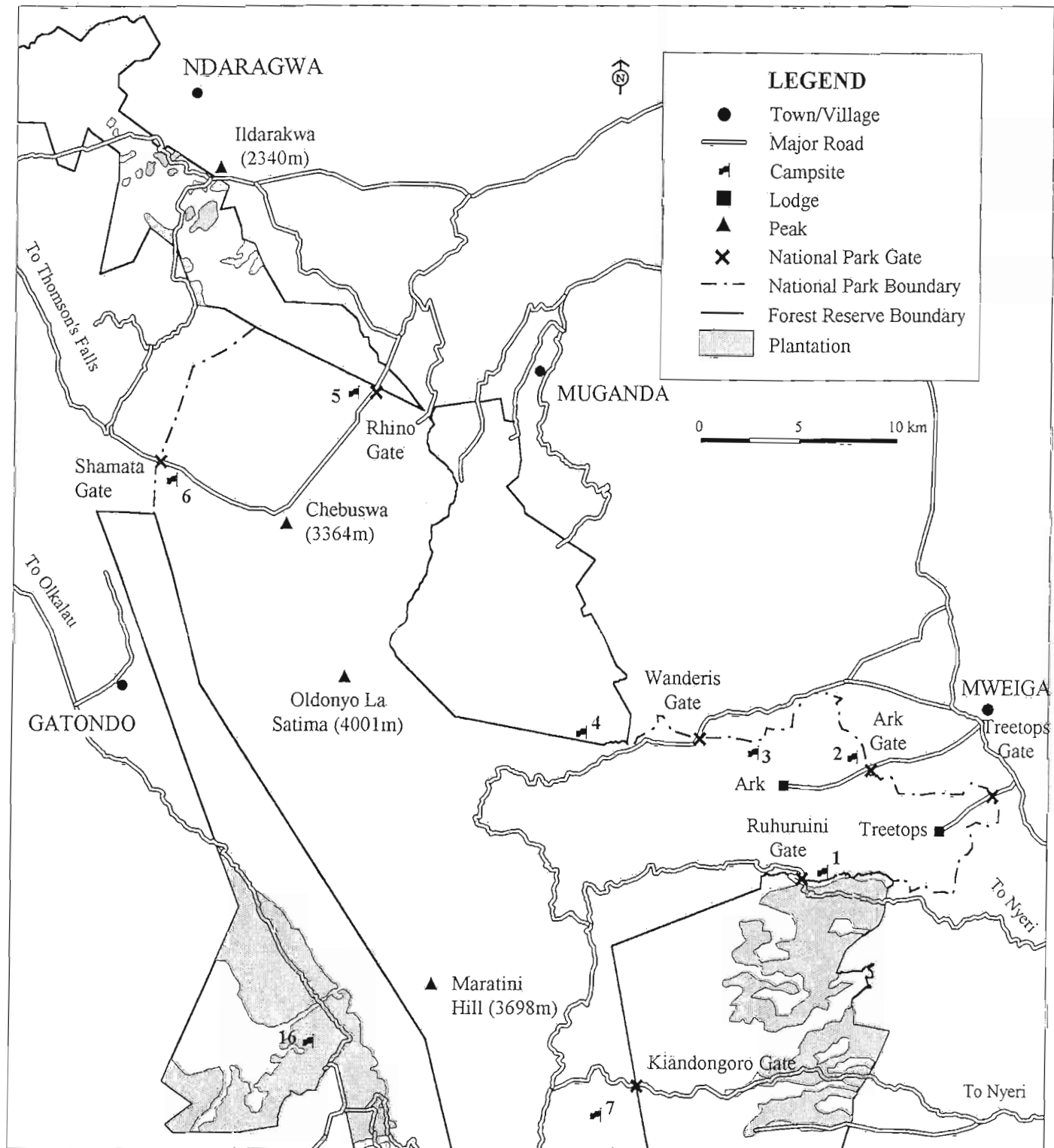
- Interviews of 384 people in 53 local communities (Appendix I, Map 17).
- Ninety-three vegetation transects at 32 sites (Appendix II, Map 18).
- One hundred fifty-eight 15-minute bird censuses at 32 sites (Appendix III, Map 19).
- Thirty-two elephant and buffalo dung pile surveys over a distance of 250 km (Appendix IV, Maps 20 & 21).

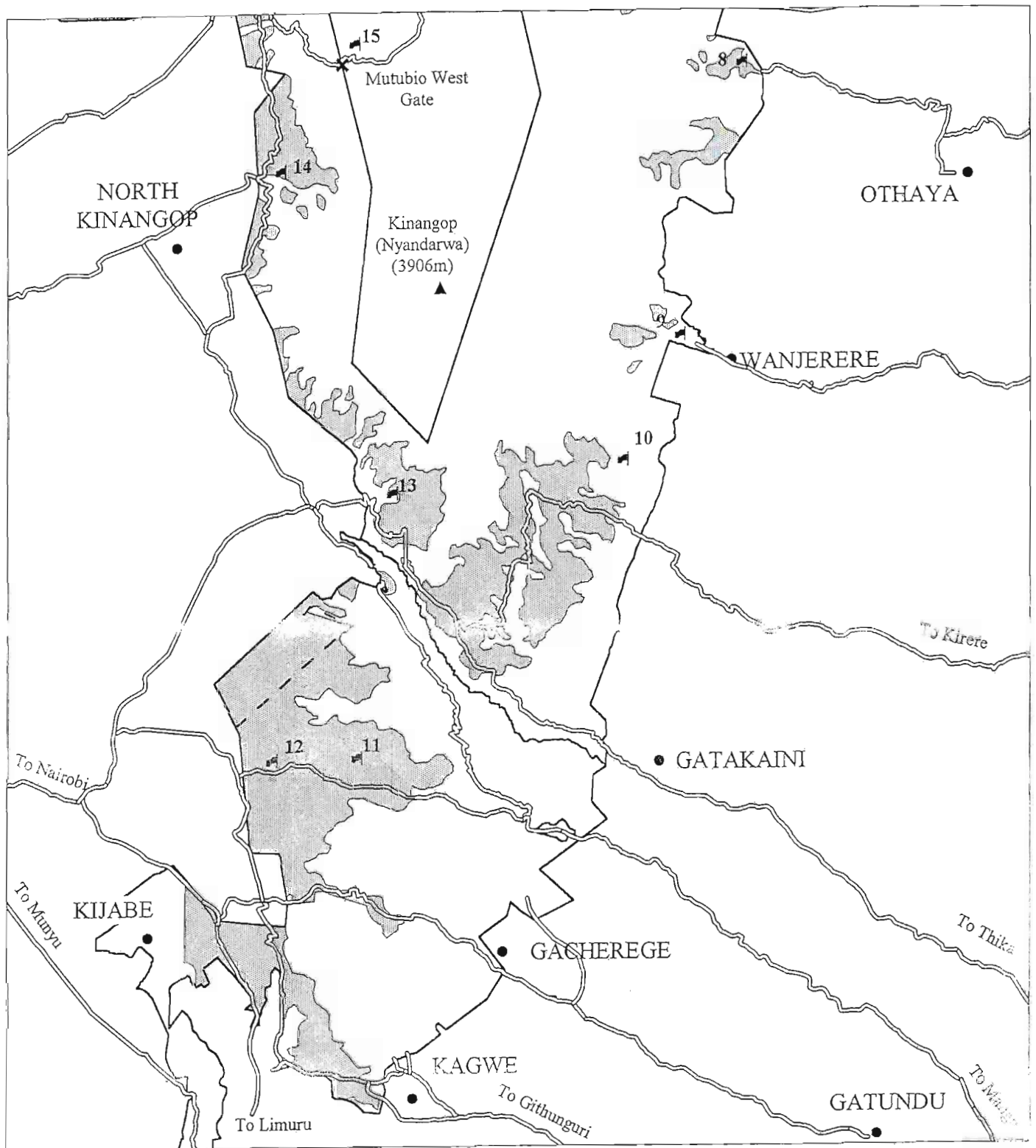
2.5 THE RESEARCH TEAM

The research team comprised of the following people:

- Tom Butynski, PhD. Team Leader. Wildlife Ecologist/American. Senior Conservation Biologist and Leader of Zoo Atlanta's Africa Biodiversity Conservation Program. Vice-Chair for Africa, IUCN/SSC Primate Specialist Group. Member, IUCN/SSC Antelope Specialist Group. Senior Editor, African Primates. Former Director, Institute of Tropical Forest Conservation. Thirty years of field research and conservation work in Africa, primarily in the montane forests of Uganda, Kenya, Tanzania and Congo.
- David Kiama, MSc. Team Botanist. Plant Ecologist/Kenyan. Works for the Department of Resource Surveys and Remote Censusing (DRSRS).
- Joseph Kirathe, MSc. Team Interviewer/Interpreter. Wildlife Biologist/Kenyan. Conducting PhD research on primates at Tana River Primate National Reserve.
- James Fuller, BSc. Volunteer Team Interviewer (first 80% of study). Biologist/American. Was with Zoo Atlanta's Education Program. Now Production Editor, Nature's Best magazine.
- Simon Ndarangu. Team Interviewer/Interpreter. Kenyan.
- Ryan Matthews, BSc. Volunteer Team Interviewer (last 20% of study). Wildlife Biologist/Canadian.

Map 3. Main roads in the Aberdares Conservation Area, Kenya, and the locations of campsites used during this study (1997 - 98).





Key to map of 16 campsites used during the Aberdares ecosystem wildlife fence placement study (1997-98). See Map 3.

Phase	Campsite	Location
1	1	Ruhuruini Gate
	2	Ruhutti River
	3	Honi River
2	4	Gakanga Ranger Station
3	5	Rhino Gate
	6	Shamata Gate
4	7	Kiandagoro Fishing Camp
	8	Thuti Forest Guard Station
5	9	Wanjerere Forest Station
	10	Gatare Forest Station
6	11	Kieni Forest Station
	12	Kamae Forest Station
7	13	South Kinangop Forest Station
	14	Mutarakwa Forest Station
	15	Mutubio West Gate
8	16	Geta Forest Station

3. DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

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

"Aberdares ecosystem": This includes all of the ground from 6,100 ft (1,850 m) around the Aberdares Range up to the highest point in the Aberdares Range (13,125 ft, 4,001 m). This encompasses not only natural habitats at the higher elevations, but also a large area at the lower elevations where there is a high human population density and intensive agriculture.

"Aberdares Conservation Area": This comprises the more or less contiguous protected areas of the Aberdares Range. These are the Aberdares National Park and Aberdares Forest Reserves.

"Aberdares Forest Reserves": These comprise the Aberdares Forest Reserve, Kikuyu Escarpment Forest Reserve, and Kipipiri Forest Reserve.

"Local People" or "Local Community": People or communities located within 3 km of the boundary of the Aberdares Conservation Area.

"Encroachment": Cultivation, grazing, occupation or other use of land within the Aberdares Forest Reserves (natural forest or plantations) which is without the authority of Forest Department or, if with authority from Forest Department, appears to not be following Forest Department or Government of Kenya policy concerning the utilization or protection of Forest Reserve land or natural forest.

3.2 ABBREVIATIONS

ADB	African Development Bank
ANRDP	Aberdares Natural Resources Development Project
DHVC	DHV Consultants, The Netherlands
DRSRS	Department of Resource Surveys and Remote Sensing
EANHS	East Africa Natural History Society (Nature Kenya)
ECCWP	Elephant Conservation and Community Wildlife Programme
EIA	Environmental Impact Assessment

FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GOK	Government of Kenya
IUCN	International Union for the Conservation of Nature and Natural Resources
KTDA	Kenya Tea Development Authority
KTZDC	Kenya Tea Zone Development Corporation
KIFCON	Kenya Indigenous Forest Conservation Programme
KWS	Kenya Wildlife Service
MGM	MGM Environmental Solutions Limited, Consultants, UK
MOU	Memorandum of Understanding
MPANP	Management Plan for Aberdare National Park
MENR	Ministry of Environment and Natural Resources
NEAP	National Environment Action Plan
NGO	Non-Governmental Organization
SSC	Species Survival Commission

4. PROTECTIVE MEASURES

4.1 HUMAN-WILDLIFE CONFLICT AND ILLEGAL EXPLOITATION OF NATURAL FOREST

During the 19th Century there has been 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. Kenya is one of these countries. As human populations grow, the natural resources available to each individual become increasingly less and wildlife populations become both reduced in size and compressed into ever smaller areas. 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.

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

With extensive loss of habitat, populations of some species of wildlife (e.g., elephant) have become compressed into increasingly small areas. At the same time, human population densities have continued to increase on the boundaries of protected areas and, as resources have become more scarce, people have become less tolerant of the negative impacts of wildlife.

Elephant probably cause the most damage to crops and property around the Aberdares Conservation Area. Damage by buffalo, baboon, Sykes' monkey, bush pig, and crested porcupine can be locally important (Anon., 1991; KIFCON, 1992; Appendix I). The main food crops consumed or trampled by wildlife around the Aberdares are maize, beans, Irish potatoes and wheat. Lion, leopard, spotted hyaena and baboon sometimes kill livestock on the Aberdares, but this is not a serious, widespread problem.

While wild animals encroach upon and do damage to agricultural lands and exotic tree plantations, people around the Aberdares Conservation Area encroach on protected wildlife habitat, destroying the wildlife directly through poaching, or indirectly by degrading or eliminating the habitat on which wildlife depends. Around the Aberdares, the pressure to illegally remove forest products, or to illegally destroy forest to establish agricultural plots is high.

At this time, the authorities are unable to effectively manage the Aberdares Conservation Area, or protect the crops, livestock and people around this Area. Establishing a barrier to the movement of wildlife out of the Aberdares Conservation Area, and to the movement of people into this Area 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 this area is eliminated.

4.2 TYPES OF PROTECTIVE MEASURES

Various defence 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 (improve attitudes, monetary compensation, revenue sharing, etc.);
- Deterrence of wild animals (direct deterrence by residents, disturbance hunting, change cropping practices, bright light, fire, noise, dogs, etc.);
- Removal of animals (control shooting, problem animal removal quotas, translocation, chasing, etc.);
- Changing the habitat;
- Construction of physical barriers.

4.3 WHY A PHYSICAL BARRIER FOR THE ABERDARES?

Most of the original natural forest of the Aberdares ecosystem has been destroyed for agriculture, while most of what remains has been degraded through the unsustainable removal of forest products. The relatively pristine areas of natural forest that remain are within the National Park and confined to the higher elevations. Given the high demand for land and forest products in central Kenya, all of the Aberdares Conservation Area must be considered under threat at this time.

All around the Aberdares Conservation Area there is a high level of human activity and complete loss, or near complete loss, of forest right up to the boundary. Once a "hard edge" like this has developed, there is little option for conservation of an ecosystem but to separate the ecosystem 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 measures 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 fence.

4.4 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."

4.4.1 Game Moat

Game moats were widely constructed during Kenya's colonial period, particularly in Laikipia District, on Mt. Kenya, at Maralal, and in Meru, Tsavo, and Aberdares National Parks. In the Aberdares, 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/2km of moat and that the entire moat be checked 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 constructed 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; Hoare, 1992; 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 problems. 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 much of the Aberdares to be unsuitable for the construction of moats. Most of the perimeter of the Aberdares Conservation Area is on hilly terrain where rainfall is relatively high (mean annual rainfall greater than 1,400 mm in most places), and where there are numerous streams and rivers. 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 constructed, such as on the more gentle terrain of the southern Aberdares, there are serious problems with illegal encroachment and unsustainable exploitation of the natural forest. 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 Aberdares.

This study did not find any area around the perimeter of the Aberdares Conservation Area where controlling human access and exploitation was not critical to conservation. This report, therefore, strongly recommends against the construction or rehabilitation of moats in the Aberdares.

4.4.2 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. Electric fences require a daily control of the fence's conductivity and voltage, and immediate repair. No fence is 100 percent 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.

4.4.3 Other Physical Barriers

Stone walls, stock fences with hot wires, and multistrand 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 Aberdares fence must be designed to control.

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 developed and 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 around the Aberdares Conservation Area. 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 area natural habitat or of pasture and cropland. Opuntia vulgaris 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.

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

Table 1. Effectiveness, environmental impact and cost of elephant control methods used in Kenya. Source: DHVC (1992).

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

is only about half as great when constructing an electric fence as when building a moat.

A total 400 km of electric fence is recommended for construction around all or part of seven of Kenya's protected areas under the European Union funded Kenya Elephant Conservation and Community Wildlife Programme. The Aberdares Conservation Area is not one of the seven protected areas considered under this project. The ECCWP began in 1993. To date, 154 km of fence has been erected under the ECCWP. In a recent review of this project, MGM (1999) found that the fence constructed to date was effective in reducing wildlife-human conflict, and recommended that the construction of electric wildlife fence continue to be supported by the European Union under this project.

5. BACKGROUND TO THE ABERDARES WILDLIFE FENCE PROJECT

5.1 INTRODUCTION

It was initially suggested that the "Aberdares Natural Resources Development Project" (ANRDP) fund the construction of an electric fence along the entire boundary of the Aberdares Conservation Area (FAO, 1994). Such a fence would, in effect, enclose all that remains of the Aberdares natural ecosystem.

The Aberdares Conservation Area has a perimeter of approximately 565 km (FAO, 1994). However, roughly 205 km of this perimeter is accounted for by two sizeable forest reserves (Kipipiri and Kikuyu Escarpment Forest Reserves) and a northern extension of the Aberdares Forest Reserve known as the Ndaragwa Forest. In order to shorten the fence, and to leave outside of the fence some badly encroached and damaged forest reserve areas, FAO (1994) recommends that large parts of the Ndaragwa Forest, and of the Kipipiri and Kikuyu Escarpment Forest Reserves, not be included within the fenced area. Otherwise, FAO (1994) recommends that the fence be placed along the existing boundary to the Aberdares Conservation Area, but with the suggestion to avoid badly encroached areas and regions where there are numerous roads/tracks entering the conservation area (in order to minimize the number of gates), and to construct the fence as straight as feasible in order to reduce the length of the fence and its construction and maintenance costs. Taking these considerations into account, FAO (1994) estimated that the fence would be about 360 km in length on the ground.

Using 1:50,000 maps and the computer software Map-Info, the total length of the fence recommended by this study is 312 km (Table 2). The "true" total length of the Phases 1, 2 and 3 fence, as measured on the ground, is 113 km (K. Kuhle, pers. comm., 1999). Using 1:50,000 maps and Map-Info, Phases 1, 2 and 3 totalled 111 km in length. This suggests that the estimate of 312 km for the total length of the fence is close to the true length.

As of July, 1999, about 90 km (29%) of fence had been constructed and 130 km (42%) cleared.

5.2 COST OF THE FENCE

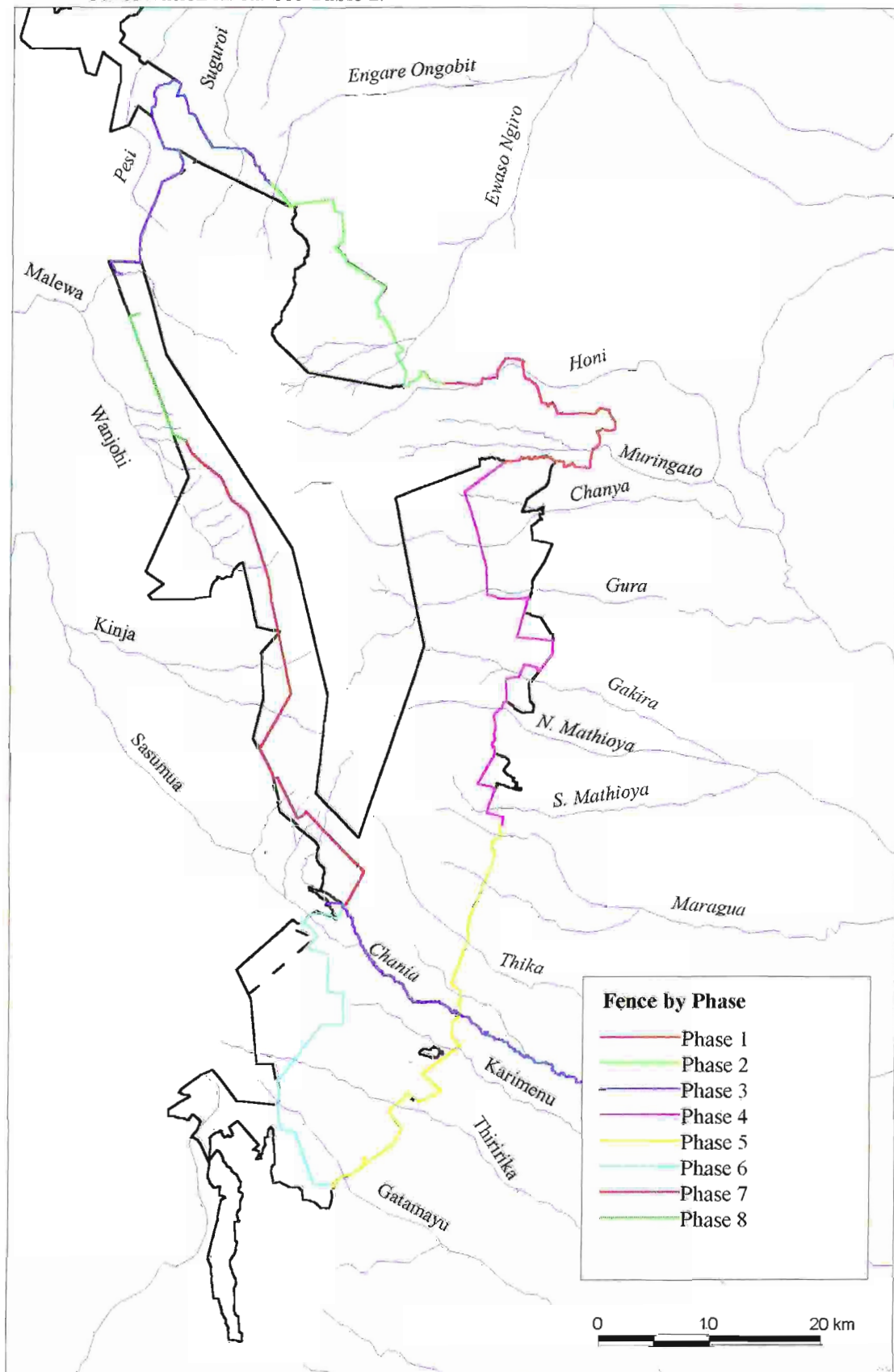
FAO (1994) estimated the cost of the 360 km long fence which was proposed for construction at that time to be approximately US\$ 8 million. The cost to construct a kilometre of electric fence was estimated in 1994 to be US\$ 27,000. Once construction is completed, the annual cost of maintaining the 360 km fence was estimated to be ca. US\$ 440,000 (at 1994 prices). J.W. Kagiri

Table 2. Summary of the number, location, and length of each phase of the Aberdares wildlife fence. These are the phases of the fence used in this report (Map 4). Distances for Phases 1-3 measured on the ground. Distances for Phases 4-8 measured from 1:50,000 maps using Map-Info.

Phase number	Location	Fence (km)
1	From Wanderis Gate around the Salient to Ruhuruini Gate (Nyeri District).	37
2	From Wanderis Gate to Rhino Gate (Nyeri & Nyandarua Districts).	34
3	From Rhino Gate to the Malewa River canyon (Nyandarua District).	40
4	From Ruhuruini Gate to the Karuromo Road between the South Mathioya and Maragua Rivers (Nyeri & Muranga'a Districts).	49
5	From Karuromo Road to the Mweri River (not Moedi River) Kiambu Districts).	46
6	From Mweri River (not Moedi River) to the Thika-Njabini Road near the South Kinangop Forest Station Road (Kiambu District).	39
7	From the South Kinangop Forest Station Road to the Chitohi River (Nyandarua District).	51
8	From the Chitohi River to the Malewa River (Nyandarua District).	14
Total		312

(in litt., 1999) undertook a detailed analysis in 1999 of the costs of maintaining the Aberdares fence. He found that it costs US\$ 750/km/year (at 1999 prices) to maintain the fence the 90 km of fence already in place. Thus, the 312 km fence proposed here for the Aberdares Conservation Area would cost ca. US\$ 230,000 per year to maintain.

Map 4. Recommended location of the eight phases of the wildlife fence around the Aberdares Conservation Area. See Table 2.



5.3 CONSTRUCTION OF THE FENCE

Before the electric fence can be constructed, a 5-10 m wide swath must be cleared of vegetation [Kuhle (1989) and FAO (1994) indicate a 12 m wide fence-line]. 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 out side.

FAO (1994) states that the fence should not be constructed over terrain too steep for the construction of a dirt track for 4 wheel-drive vehicles. This study suggests that it is both unnecessary and undesirable to meet this requirement as concerns the construction of the fence in the Aberdares. Although construction and maintenance of the fence will be difficult in some places due to the steep ground and the absence of a maintenance road, this does not necessarily mean that a fence cannot be constructed and maintained along a narrow (ca. 5 m) swath over all but the steepest terrain. Elephants and humans both travel over fairly steep terrain and will certainly move in and out of the protected area at sites where there is no fence. The only exception being extremely steep terrain.

Technical aspects of the construction of the fence, and of power supplies to the fence, are covered in detail in FAO (1994) and will not be repeated here. The fence is, however, considered of appropriate design and quality for the task for which it is being constructed. According to the final evaluation report of the Elephant Conservation and Community Wildlife Programme (ECCWP) (MGM, 1999), "The design and specifications of the fences constructed by ECCWP are of a high standard, and the technical quality of construction is also good. The fences are well-sited...". Nonetheless, MGM (1999) does make some recommendations for technical improvements that would further raise the quality of the fence.

For the past 3 years a team of Kenya Army engineers has been clearing the fence-line for the Phase 4 fence. This work is being done under a Memorandum of Understanding between the Ministry of Defence and KWS. This MoU seems to be working well to the mutual benefit of both parties. The Army engineers receive on-the-ground training and practical experience, while KWS saves considerably on construction costs. In addition, the fact that the Kenya Army is involved with the construction of the fence gives the fence "more respect" in the eyes of the local people. This is also a strong indication that the Government of Kenya both supports this fence and recognizes its success thus far.

5.4 PHASES OF THE FENCE

There has been considerable confusion and uncertainty as to the number of phases for the wildlife fence around the Aberdares Conservation Area, and where each phase begins and ends. For example, Kuhle (1989), KWS (1991), Munai (1991) and FAO (1994) state that there will be seven phases, while an undated map by Rhino Ark and FAO (1997) indicate nine phases. While there is no discrepancy for Phases 1-3, there is for all of the remaining phases. The only graphic description of where each phase begins and ends is provided in KWS (1991), while the only written description of where each phase begins and ends is provided in FAO (1994). All reports, except KWS (1991) are vague as to the location of the phases along the west side of the Aberdares Conservation Area. This report takes Phases 1-6 as described in FAO (1994) and then describes two more phases for a total of eight phases (Table 2, Map 4). It should be noted that the phases as shown in Map 4 of FAO (1997) are different from those described in FAO (1994) and in this report. For example, in FAO (1997), Phase 4 is about half the length given in FAO (1994), while Phases 5 and 6 are Phases 4 and 5 in FAO (1994), and Phase 7 is Phase 6 as described in FAO (1994).

5.5 POSITIVE IMPACTS OF THE FENCE

A well built, and properly maintained and monitored wildlife fence around most or all of the Aberdares Conservation Area 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. Fencing 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 clear and effective physical barrier to agricultural encroachment, prevent 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 Aberdares ecosystem for the benefit of the present and future generations. It will also serve to create a more positive national and international image for Forest Department, KWS and the Government of Kenya.

DHVC (1992) suggests that without an electric fence between Kenya's protected area 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 22 km long "Naari Forest Reserve Electric Fence" was constructed on the NE slope of Mt. Kenya from September 1996 - April 1997. This fence was built in ecological, human and socio-economic environments similar to those on the slopes of the Aberdares Conservation Area. As with the Aberdares 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 the human-wildlife conflict problem (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 Non-residential 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."

5.6 NEGATIVE IMPACTS OF THE FENCE

Reports by Munai (1991), DHVC (1992), FAO (1994, 1997) and Ngoru (1998) suggest that a well built, and properly maintained and monitored wildlife fence around most or all of the Aberdares Conservation Area 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 around part or all of the Aberdares Conservation Area. 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 Aberdares. 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 Aberdares is already essentially an isolated island ecosystem given the near complete destruction of natural habitats all along its perimeter by farmers, loggers, and others. While an electric fence serves as a barrier for a few dozen of the larger species of mammals, 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 Aberdares Conservation Area because there is no suitable habitat to move through. Thus, the free movement of animals in the Aberdares Conservation Area 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 Aberdares 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 the Aberdares Conservation Area and the "island effect" is already at work. All evidence

suggests that without the fence, "Aberdares 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 Aberdares probably have enough habitat in which to maintain adequate populations. Several species of larger mammals are perhaps at risk, however, The following species may be in critically low numbers in the Aberdares at this time: bongo Tragelaphus euryceros, eland Taurotragus oryx, common zebra Equus burchelli, giant forest hog Hylochoerus meinertzhageni, and black rhinoceros Diceros bicornis. These five species are in low numbers not as a result of a fence, but rather because no fence is in place. Their decline is the result of a combination of 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 Aberdares. Historically, elephants probably moved in all directions into and out of the Aberdares, 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 use is the one which connects the Aberdares to the Laikipia rangelands to the north.
- The placement of the wildlife fence as recommended in this report would place about 73% (ca. 324 km²) of the existing exotic tree plantations of the Aberdares Conservation Area outside of the fenced area. These plantations currently receive considerable damage from wildlife, particularly from elephants. Outside of the fence they will be largely protected from wildlife. While the plantations located within the fence are expected to receive increased damage from wildlife, it should be noted that these plantations are already unproductive and uneconomical, and that they are a focus of much illegal activity. Most have been harvested and not replanted, while many of the remainder are burnt, or left 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 this conservation area, 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.

5.7 COMMENTS ON THE FENCE

All people concerned with the Aberdares Wildlife Fence Project 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 around the Aberdares appears 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 the Aberdares wildlife 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, the observations made in the field strongly indicated that the funds, and the community and political support for the Aberdares Wildlife Fence Project 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, KWS, Forest Department, local authorities, politicians, and donors must all come to realize this, and then to work together to construct and maintain this fence.

In its report on wildlife fences, DHVC (1992) estimated that construction of the fence around the Aberdares Conservation Area would cost US\$ 8-10 million. Nonetheless, DHVC concluded that the costs of not fencing far outweigh the costs of fencing. Ten million dollars is a large amount of money for a wildlife fence, particularly for a developing nation. This is, however, a small investment when the potential long-term direct and indirect benefits of a healthy Aberdares ecosystem are considered. The water alone from this ecosystem must be worth well over US\$10,000,000 every year to the people of Kenya and, as with other natural resources, water will become increasingly valuable as Kenya's human population increases. In addition, the fence is expected to confer many other benefits, both short- and long-term to the local people and to the nation. For example, many forest-adjacent communities will experience a considerable reduction in damage by wildlife, particularly elephants, to crops and farm infrastructure. One result should be a substantial increase in farm income.

6. FENCING POLICY, GUIDE-LINES AND OTHER CONSIDERATIONS

6.1 FOREST DEPARTMENT POLICY GUIDE-LINES ON FENCING IN FOREST RESERVES

According to Forest Department guide-lines 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.

6.2 PRIMARY CONSIDERATIONS FOR PLACEMENT OF THE FENCE AND GATES

In making decisions on where to place a wildlife fence, a large number of factors must be taken into consideration. The recommendations made in this report for placement of wildlife fence around the Aberdares Conservation Area were made in an attempt to minimize a number of factors, while taking into consideration the Forest Department Policy Guide-lines on Fencing in Forest Reserves (Manegene et al., 1996). These 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 Aberdares as possible. This is a Forest Department guide-line (Manogene et al., 1996).

- 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 Aberdares Protected Area the fence is located the steeper and more rugged the terrain (since the highest points of this protected area are in its centre), and the more difficult the logistics. Thus, building the fence, when possible, on the edge of the Aberdares Conservation Area minimizes costs, problems and environmental damage.
 - Gates: The larger the number of vehicle and pedestrian 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 Aberdares Conservation Area. A large percentage of the plantation forests in the Aberdares Forest Reserve are perimeter plantations. While plantation forests have some value for some wild species of plants and animals, this is both limited and trivial compared to the conservation values of the natural forest. The main value of plantation forests to conservation of biodiversity within the Aberdares natural ecosystem is that, when properly managed, they can meet many of the needs of the local people for forest products. That is, they can take much of the pressure for forest materials off of the natural forest. The proper management of existing plantations adjacent to and near the Aberdares Conservation Area is vital to the long-term survival of the natural ecosystem. While enclosing these plantations within a fence would assist Forest Department in controlling entrance by people, livestock and vehicles, there would be many serious downsides to this. Some of these are mentioned here:
 - Fencing in the perimeter forest plantations would greatly increase the length of the fence.
 - Left outside of the fence, perimeter plantations will

serve as a major buffer zone between the local communities and the fence. Obviously, this buffer zone does not exist where plantations are within the fenced area.

- Plantations suffer considerable damage by wildlife, particularly elephants. Enclosing a plantation within the fenced area will lead to an increase in damage and loss to wildlife (especially since some wildlife populations are expected to increase under the protection of the fence).
- Plantations have a high human presence. This includes Forest Department personnel, loggers, and local people who maintain shambas, collect fuelwood and poles, and graze cattle within plantations. Once people are inside of a plantation that lies within the fenced area, they will have ready access to the natural forest. In other words, controlling and managing these people will be an enormous and expensive management problem, largely defeating one of the main objectives of having a fence.
- All plantations have numerous existing access points, including roads and footpaths. Some of these access points would need to be incorporated into any fence which encloses the plantation. As mentioned above, the number of gates through the fence should be minimized as they are expensive to construct and particularly expensive to effectively man. Placing the fence between the plantation and the natural forest more or less eliminates this problem as relatively few gates would be required for access to the natural forest.
- Kenya badly needs its forest plantations, and this need is growing every day. Where practical, these plantations should remain outside the fence in order to help meet this demand.
- 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 most cases, these plantations lie deep within the Aberdares Conservation Area. To not include enclosed plantations 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 either protect these plantations from wildlife or to control access to them (and to the surrounding natural forest). Also, unlike perimeter plantations, enclosed plantations do not serve as buffer zones either to the fence or to the natural forest. In fact, they do quite the opposite by promoting a high level of human activity and disturbance deep within the Aberdares

Conservation Area. All existing enclosed plantations, most of which are already unproductive and unsustainable, should have their poles and timber culled, and abandoned to eventually revert back to natural forest. Where the Forest Department infrastructure on these plantations is not of use by those Forest Department or KWS staff assigned to forest and wildlife protection activities, the infrastructure might be considered for use by tourists. Otherwise, the infrastructure should be removed.

- Minimize the number of gates (KIFCON, 1992). Gates are expensive to construct and are particularly costly to effectively man. 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 Aberdares Forest Reserve which can be legally and sustainably exploited for local consumption. Where perimeter plantations exist, forest products will be available outside of the fenced area and few gates will be needed to the natural forest. Where perimeter plantations do not occur, and where local communities are adjacent to the Forest Reserve, people will require access to the natural forest. 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, Forest Department and KWS might well 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.

Since forest products cannot be legally removed from a national park, no additional public gates are needed where local communities are adjacent to the Park. At present, there are eight access roads for use by KWS and visitors to the Park. In addition, this report recommends that there be two pedestrian gates in the southern Aberdares for hikers to the Kinangop Peaks. These 10 gates should be adequate for meeting all visitor needs and most KWS needs. KWS and Forest Department will both, however, require that there be non-public ("official") gates along the fence so that entrance can be gained from time to time through a series of gates for management and protection purposes (e.g., research, fire fighting, anti-poaching patrols).

6.3 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 KWS and Forest Department 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. KWS and Forest Department, 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 ANRDP should be to help ensure that local communities are directly involved in negotiating fence maintenance agreements and access to the Forest Reserve, and that at least some of the casual labourers for fence construction and maintenance are hired from the 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.

6.4 CONCERNS ABOUT UNFENCED PROTECTED AREA LAND

The "Forest Department Policy Guidelines on Fencing in Forest Reserves" (Manegene *et al.*, 1996) states that "where plantations occur, the fence should be constructed between the indigenous forest and the plantation when feasible". This study has closely followed this guide-line. There are, however, serious concerns with not enclosing all plantations and all natural forest within the fenced area (Section 7.2.15). These are briefly discussed here.

- The greatest concern is that once the fence is up, local people, officials and others may be anxious to perceive the unfenced areas as no longer part of the Aberdares Conservation Area and, therefore, as prime sites for encroachment or excision (degazettement). To help guard against this possibility, KWS and Forest Department have a policy that wherever a fence is placed between plantation and natural forest, the outside boundary of the plantation must be clearly demarcated and understood by the local communities and officials. Clearly and permanently demarcating the boundary of the Forest Reserve at the same time that the electric fence is being constructed will send a clear message to all that this is still Forest Reserve land and under active management and protection. Also, the protection and use of Forest Reserve land outside of the wildlife fence should be a major point for discussion and agreement with local communities prior to construction of the fence. Protecting Forest Reserve land that is outside of the fence should not be a big problem if (1) there are firm agreements with the local communities, (2) if local people come to view the wildlife fence, the natural forest, and the plantations as assets vital to their well-being, and (3) if they play a significant role in the maintenance and protection of the fence and Forest Reserve boundary.
- For the larger species of animals, fenced-out areas represent a loss of habitat (albeit often marginal habitat), possibly leading to reduced food availability, over-crowding, and damage to the natural habitat. This, however, will likely be more than compensated for by reduced degradation and loss of that habitat which is within the wildlife fence. There is no indication that any species in the Aberdares Conservation Area is at present at carrying capacity. What limited baseline information that exists for the Aberdares suggests that all species of large mammals are well below their historic population levels. Except for the wild dog, the Aberdares still has its full array of large predators (*i.e.*, lion,

leopard, spotted hyaena). These predators will help keep this ecosystem in balance.

- There is also the concern that areas left outside of the fence, particularly the plantations, will continue to have low productivity as a result of continued poor management. Since there is a direct link between the productivity of the plantations of the Aberdares Forest Reserve and the well being of the Aberdares natural ecosystem, a major focus of the ANRDP should be to ensure that all plantations around the Aberdares are once again well managed and productive. With construction of the wildlife fence and reduced access to products (particularly illegally acquired products) from the natural forest, there is expected to be renewed interest by all parties concerned with the proper management of the plantations.

7. RECOMMENDATIONS AND MITIGATION MEASURES FOR FENCING

7.1 PRIORITY AREAS FOR CONSTRUCTION OF THE ELECTRIC FENCE

According to FAO (1994), "Implementation phasing of the fence is based on the necessity for the project to first gain sufficient experience with community involvement and to also provide time for the more territorial queries to be settled. As the latter are expected to arise in the eastern and southern parts, project activities will first concentrate on finalizing the northern part until the steep western escarpment near Kipipiri forest is reached. After which the project will resume activities in the southern part of Nyeri District and proceed clockwise around the planned boundary line until project completion."

Priority areas for fence construction as determined by this study differ in some respects from those presented in FAO (1994).

At this time, the Aberdares fence has been constructed over Phases 1 and 2, and over about the first one-third of Phase 4. In addition, the fence-line for Phase 3 has been cleared and awaits construction of the fence. Based upon the findings of this study, the priority areas for fence construction are as follows (beginning with the highest priority areas first):

1. Continue construction of the Phase 4 fence from the present location of fence construction on the Gura River south to the Thuti (Zuti) Plantation. That is, complete fencing of the second sector of Phase 4 (Section 16.5). Do not fence the third sector of the Phase 4 fence at this time, however, as this area, although biologically very important, has relatively little illegal activity or human-wildlife conflict. Instead, begin construction near the middle of Phase 5 ca. 20 m north of the Thika-Naivasha Road and establish the vehicle/pedestrian gate here.
2. From the Thika-Naivasha Road go south to the end of Phase 5 and then continue north completing construction of the fence over both Phases 6 and 7 (*i.e.*, up to the north end of Phase 7 at the Geta Gate). This region contains the largest areas of agricultural encroachment in the Forest Reserve, high levels of illegal and unsustainable exploitation of the natural forest, and the highest levels of human-wildlife conflict of the unfenced portions of the Aberdares.
3. From Geta Gate, go to the west end of Phase 3 at the Malewa River and complete construction of the Phase 3 fence to Rhino Gate.

4. From Rhino Gate, return to Thuti Plantation and complete construction of the fence along Phases 4 and 5.
5. If by the time all of the fence mentioned above is constructed, the Phase 8 area still has encroachment or significant levels of other illegal exploitation, then the Phase 8 area should be fenced beginning at Geta Gate.
6. If by the time all of the fence mentioned above is constructed, the Kipipiri Forest Reserve still has encroachment or significant levels of other illegal exploitation, then this Forest Reserve should be surveyed and evaluated for a possible wildlife fence around all or part of its perimeter.

7.2 MITIGATION MEASURES

7.2.1 Introduction

Discussed here are a number of mitigation measures that, if implemented, would either enhance the beneficial impact of the wildlife fence or reduce the negative impact of the fence. All of these activities will benefit all eight phases of the fence and, therefore, should be broadly applied. Later in this report, under the detailed discussion of each phase of the fence, are listed additional mitigation measures and recommendations which are specific for that phase.

7.2.2 Communities Help More with Fence Maintenance

Long-term proper maintenance of the fence is probably the biggest problem and challenge faced by the Aberdares 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. In the construction of the Phase 1 and Phase 2 fences, the clearing of the Phase 3 fence, and the early clearing of the Phase 4 fence, Forest Department and KWS did not involve local communities in fence-line clearing or fence construction as much as they could and should have. As

mentioned in FAO (1997), "An opportunity has been lost in terms of both stakeholder ownership and income-generation." This mistake has been recognized and there is now considerable participation by the local people in these fencing activities.

At this time there are no formal arrangements between KWS and local communities for assistance from the local communities for maintenance of the Aberdares wildlife fence. This is both surprising and worrisome. Formal agreements should be put into place as soon as possible. These must clearly specify and detail the obligations of KWS and of local communities in fence construction and maintenance. As pointed out by MGM (1999), "The lack of sufficient maintenance provision poses a significant threat to the sustainability of this investment." Fence construction and fence 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.

7.2.3 Change Local Community Attitudes Towards 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 the Forest Reserve is guided by this principle. They should also be aware that as the natural forest of the Aberdares recovers its 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 the Aberdares Conservation Area is a vital national asset, and that access to this area, and particularly the taking of forest products, is a "privilege" 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 restricted further.

7.2.4 Consult Communities about Location of Gates

Forest Department 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, water is the most important resource that people obtain from the Forest Reserve (particularly in the Phase 3 area). It still needs to be determined whether this study located all of the watering points within the Forest Reserve that local communities

require access to during periods of drought. If there are drought period water sites that this study did not recognize, then "drought period gates" need to be constructed that can be opened and monitored during such times. These gates should, however, allow access to the Forest Reserve only during periods of drought and entrance must be only for the taking of water (*i.e.*, there should be no taking of other forest products or grazing). In some cases, KWS, Forest Department and the ANRDP may find that an alternative to "drought period gates" is to assist local communities in the construction of community reservoirs and boreholes. This approach may be less expensive, easier to manage, less damaging to the environment, and more appreciated by the local communities than "drought period" gates".

7.2.5 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. During this study it was noted that some pedestrian gates need to be better manned. Although the fence has greatly reduced the illegal taking of forest products, and our observations indicate that most gates are diligently manned, this is not always the case. Forest Department, 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 Aberdares Conservation Area. All parties must make a concerted effort to consistently enforce regulations governing access to the Conservation Area and the taking of forest products. This will help reduce misunderstandings, mixed-messages, and abuses of the system. The present system for monitoring the gate guards should be reviewed and perhaps restructured as part of the fence maintenance strategy..

7.2.6 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.

7.2.7 Limit Fence Perimeter Roads

As recommended by FAO (1997), maintenance of the fence should be undertaken on foot, bicycle, donkey or horseback, and construction of the perimeter road halted. If a perimeter road is constructed it should never be placed on steep terrain.

7.2.8 Limit Rate of Fence-line Clearance

To avoid the mistake made on the Phase 3 fence (Section 15.5),

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 current problems, including soil erosion and an increase in the illegal taking of forest products.

7.2.9 Give Fence Maintenance Priority Over Fence Construction

A high level 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 is 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 a few years ago with 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 considerable cost (J.W. Kagiri pers. comm., 1999).

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 KWS (and clearly stated in the Aberdares Fence Maintenance Strategy) that priority for these resources goes to fence maintenance at the expense of new construction.

7.2.10 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. FAO (1994) estimated that once construction of the fence is completed, the annual cost of maintenance would be ca. US\$ 440,000 (at 1994 prices). Since then a more detailed assessment of the costs of maintaining the fence has been undertaken (J.W. Kagiri pers. com., 1999). In addition, the total length of the fence that is recommended in this report (311 km) is less than the 360 km recommended by FAO (1994). The current estimate is that it will cost US\$ 230,000 per year (at 1999 prices) to maintain 311 km of fence (Section 5.2). This is 48% less than the estimate provided by FAO (1994). This may at first still 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 several 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 around the Aberdares. This will be largely in the form of salaries to ca. 92 fence maintenance workers (once the fence is completed). This alone would bring an estimated US\$ 75,000-100,000/year into the local economies. This is not an insignificant sum given the poverty in these communities.

The most obvious approach for guaranteeing long-term funding for the maintenance of this fence is to establish an "Aberdares Wildlife Fence Trust Fund". To safely generate US\$ 300,000/year, the principle of this fund needs to be ca. US\$ 5,000,000 (using an annual rate of return on investment of 6.25 %). 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 US\$ 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 "Aberdares 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 the Aberdares Conservation Area. Once people are fully aware of the importance of the Aberdares watershed to their well-being and that of their families and businesses, it should be possible to obtain funds for the Trust from individuals, businesses and industries in the Nairobi area and elsewhere around the Aberdares. 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 Aberdares hold one of Kenya's largest populations of elephants (Section 8.9.2). As such, funds for the Trust might be available from a number of the many organizations and aid agencies interested in elephant conservation.

7.2.11 Develop a Fence Maintenance Strategy

The cost of maintaining a kilometre of wildlife fence in the Aberdares is now estimated to be US\$ 750/year (Section 5.2). Therefore, with ca. 90 km of fence in place at this time, the annual maintenance cost is today roughly US\$ 68,000. As stressed above, maintenance of the fence is critical to the success of the fencing programme, as well as to the security of the Aberdares Conservation Area (Section 5). 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 (KWS and Forest Department staff, local people) clearly understands his/her role in the process of maintaining the fence.

KWS has initiated the process of developing strategies for the maintenance of electric fences around protected areas. To date, 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 more specific and more detailed draft "Aberdares Fence Maintenance Strategy" should be developed by those most experienced with fence maintenance issues and problems. The draft strategy should then be discussed among KWS, Forest Department, 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 Aberdares Wildlife Fence Trust Fund.

This study sensed that potentially serious problem for maintenance of the Aberdares fence is that some of the people at KWS who are responsible for making funds available for the purchase of fence maintenance materials may not fully appreciate fence maintenance needs or the importance of making funds available in a timely manner. This problem can probably be resolved through workshop discussions, other communications, and directives. This issue should be addressed in the fence maintenance strategy.

The strategy should also insist on the development of a simple, but thorough, "Aberdares 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.

7.2.12 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 can also be expected to emerge. Some of these may prove to be superior to electric fencing over the longer term...at least under some circumstances.

7.2.13 Promote Out-of-Forest Conservation

Dependence on wood for fuel and as a building material is placing enormous strain on the Forest Reserves of the Aberdares. 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 Aberdares Conservation Area.

7.2.14 Local People do More to Stop Crop Pests

The local people should take more responsibility for limiting damage to their crops by baboons, Sykes' monkeys and porcupines. These three species are widespread in Kenya and, therefore, cause damage to agricultural crops far from protected areas. Baboons are the most serious crop pest in Kenya. Patrols of the fence by the affected farmers (or by someone jointly hired by them) and their dogs at those times of the day and year when raids by these species are most likely to occur can be effective. Sticks, stones, catapults, noisemakers, etc., can be used with success.

7.2.15 Control Shooting and Trapping of Pests

If an effective, but inexpensive, addition to the current fence becomes available for preventing baboons, Sykes' monkeys and vervet monkeys from moving through or over the fence, then consideration should be given to making this addition to the existing fence where justified. Otherwise, control shooting and/or trapping should be considered for those areas where primates continue to be serious crop raiders.

7.2.16 More Active Problem Animal Control Units

As suggested by FAO (1997), KWS should consider deploying highly-mobile Problem Animal Control Units to discourage elephants from breaking fence and, thereby, further reduce damage to crops and property. This damage to the fence is seasonal, occurring mainly during March-August.

7.2.17 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 Aberdares Conservation Area. Community workshops, education seminars, Park and Forest Reserve tours, and grievance meetings should be organized by KWS, Forest Department and local authorities to familiarize members of the community with the Aberdares Conservation Area and the issues involved in its 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 protected area.

7.2.18 Better Management of the Natural Forest

A priority for conservation of the Aberdares ecosystem is to ensure that there is good management of the natural forest that is located outside of the Aberdares Conservation Area. Almost all of the natural forest within 10 km of the perimeter of the Aberdares Conservation Area is within Forest Reserves. Sustainable use of these natural forests would do much to meet local needs for forest products and, thereby, help keep pressure off both the fence and the natural forest within the fenced area. ANRDP and KWS should assist Forest Department in this effort. It is also vital that the large area of exotic tree plantations in the vicinity of the Aberdares Conservation Area also be protected, made productive and used sustainably.

7.2.19 Improve Law Enforcement

For whatever reasons, there is an obvious, serious and widespread lack of law enforcement on the part of Forest Department in the Forest Reserves of the Aberdares Conservation Area. This is also a problem for KWS in the Phases 2 and 3 areas (*i.e.*, at Rhino Gate and Shamata Gate). Not enforcing laws governing the taking of forest products or the use of Forest Reserve and National Park land has led to (1) over-utilization, degradation and loss of natural forest in the Aberdares Conservation Area (especially in the Forest Reserves), (2) damage of the watershed, (3) decline of public and donor confidence in Forest Department and KWS, and (4) the questioning of the capabilities, motives and professionalism of some Forest Department and KWS employees. One of the primary goals of the ANRDP must be to ensure that Forest Department and KWS

meet the challenges for effective law enforcement that the Aberdares Conservation Area presents.

7.2.20 Remove Encroachers

Agricultural encroachers now have a strong foot-hold in several places in the Aberdares Conservation Area, most especially at Geta, Kabage, Kieni, and Gathore. As has been proven again and again, these encroachers will expand their operations and further destroy the conservation values of this protected area as long as they are allowed to do so. For the good of Kenya, Kenyans, and the Aberdares Conservation Area, all encroachers should be removed from the Aberdares Forest Reserves. 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 the Aberdares Conservation Area. The wildlife fence, together with a number of concomitant conservation activities can help slow this expansion. Ultimately, however, it will take action by the higher levels of Government to reclaim these areas from the encroachers. The removal of all encroachers is strongly recommended here and should be a clearly stated objective of the ANRDP. Another recommendation is that none of the encroached upon areas be excised from the Forest Reserve. Past excisions of large areas of Forest Reserve have already greatly damaged this watershed and the conservation values of the region (Section 8.8.2).

With a large numbers of encroachers and cattle grazers to be removed from the Aberdares Conservation Area, it will be important for Forest Department and KWS to work closely with local communities and authorities to ensure that the encroachers and livestock owners 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 Forest Department 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 replanting the plantations, establishing and maintaining permanent boundary markers for the Forest Reserve, and constructing and maintaining the fence. All of these activities are good for the conservation of the Forest Reserve, for the employed encroachers and their families, for the local communities, and for Kenya as a whole. These are activities which the ANRDP should focus much of its attention and resources on as they help all interested parties and pay both immediate and long-term dividends.

7.2.21 Protect Unfenced Forest

Concern has been expressed that unfenced portions of the Aberdares Forest Reserve might be viewed by the local

communities as land that Forest Department no longer has interest in protecting (FAO, 1994, 1997) (Section 6.4). This notion can be quelled by Forest Department and KWS by further demonstrating their commitment to the conservation of these areas. This can be achieved by:

- Ensuring that all illegal activities, particularly enroachment and grazing, are stopped before, or as, the fence is constructed;
- Quickly replanting and maintaining those plantations that lie outside of the fence;
- Permanently and clearly marking the boundary of the Forest Reserve by (1) placing large concrete marker stones at every site where the fence changes directions, (2) digging a 1 m wide by 1 m deep moat all along the boundary (except on the steeper slopes), and (3) planting a "live" continuous boundary line of eucalyptus trees (perhaps intermixed with cypress and Erythrina abyssinica) just inside the Forest Reserve 2 m from the moat. Trees should be planted about 2 m apart. Replanting will be required as these trees are destroyed or otherwise die. Once the trees are large enough, "Forest Reserve" signs should be securely placed on them at 100 m intervals. As much as is possible, local people should be hired to plant and maintain plantation and boundary trees, and to dig and maintain the boundary moat.
- Conducting an active conservation education/sensitization campaign among local communities, and promoting and assisting in improved conservation practices in the local communities (e.g., fuel efficient stoves, planting of woodlots).

7.2.22 Replant the Nyayo Tea Zone

A total of 13.1 km² of species-rich natural forest has been cleared in recent years along the edge of the Aberdares Conservation Area in order to establish the Nyayo Tea Zone. Of this area, 5.3 km² are now considered unsuitable for tea. Forest Department and the ANRDP should plant this area with indigenous trees so that local people can obtain natural forest products on a sustainable basis from this source.

7.2.23 Enhance Protection to Kipipiri Forest Reserve

The Kipipiri Forest Reserve (50.8 km²) is part of the Aberdares Conservation Area but lies outside of the wildlife fence. This Forest Reserve is encroached over a large area and seriously degraded. Nonetheless, Kipipiri still holds a significant area of natural forest and bamboo. If sustainably used, Kipipiri Forest Reserve would do much to meet the needs of the local people for natural forest products and, thus, serve as an

important buffer to the forest of the Aberdares Conservation Area. In addition Mt. Kipipiri rises to 11,160 ft (3,400 m) and, therefore, is a vital watershed for the drier areas to the north and west.

Kipipiri Forest Reserve represents the largest area of natural forest in the region which will not be within the wildlife fence. This means that Kipipiri can serve as an excellent "control" and "test case" for the fence. Baseline data should be collected in Kipipiri so that comparisons can be made over time of what changes occur in the conservation values of an unfenced (i.e., Kipipiri) natural forest and a fenced (i.e., Aberdares) natural forest. Can conservation activities be identified and implemented that will conserve an unfenced natural forest such as Kipipiri? If so, such measures can probably also be applied with success to the Aberdares Conservation Area, perhaps eliminating the need for continued fencing. If, however, the present conservation values of the Kipipiri Forest Reserve have not improved by the time the fencing programme for the main block of the Aberdares Conservation Area is completed (i.e., Phases 1-8), then serious consideration should be given to also placing a fence around all or part of the Kipipiri Forest Reserve.

7.2.24 Reduce Soil Erosion

Soil erosion along the fence-line needs to be arrested. Although much of the bare ground created by fence construction will eventually be covered by 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 species. This should be done as soon as the fence-line is cleared as considerable erosion and gullyng 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 be of considerable benefit.

7.2.25 Conduct More Research on Elephants

Elephants are a keystone species in the Aberdares ecosystem. They are also a significant tourist attraction and major problem animal for the 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 movements of radio collared elephants, as is now being done in the Shimba Hills

National Reserve and in Laikipia, would be a most worthwhile research undertaking in the Aberdares.

7.2.26 Establish Artificial Salt Licks

It appears that one of the main reasons elephants move out of the Aberdares Conservation Area is to visit traditional mineral licks. Establishing artificial mineral licks that mimic as much as possible the natural licks might do much to: (1) reduce elephant damage to the fence and to the farmlands beyond, (2) replace those mineral licks that have been lost to human settlement and agriculture, and (3) reduce the density of elephants in certain areas (e.g., the Salient). This report strongly urges a review of what is known about natural and artificial mineral licks, research on salt licks and their use by elephants, and close monitoring of artificial mineral licks in the Aberdares. For example, how have mineral licks been established at game lodges in Kenya and elsewhere, what has been the impact on the environment, what lessons have been learned, and what general principles need to be followed? This interesting topic could be the basis for one or two useful MSc thesis projects.

7.2.27 Promote Ecotourism

Ecotourism, particularly community-based ecotourism, should be promoted within and around the Aberdares Conservation Area. 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 Aberdares Conservation Area.

7.3 THE ANRDP AND THE ABERDARES WILDLIFE FENCE

7.3.1 Introduction

This study recommends that the ANRDP give particular attention, and funding support, to the following activities as these are especially important to the conservation of the Aberdares Conservation Area and to the success both of the Aberdares Wildlife Fence Project and the ANRDP.

7.3.2 Support Construction of the Fence

As recommended in the ANRDP's Identification Report (FAO, 1994), the ANRDP should fully fund the construction of the Aberdares Wildlife Fence. If the ANRDP is no longer willing to do this, then the other alternative is to fully fund the Aberdares Wildlife Fence Trust Fund. Rhino Ark and KWS have funded the construction of the fence to date. They have done an excellent

job under difficult circumstances. Fence construction has been slow however, largely due to insufficient funding. Funds from ANRDP for fence construction would enable the fence to be built quickly before much additional damage is done to this ecosystem. Rhino Ark might then be able to focus its efforts on securing the needed money for the Aberdares Wildlife Fence Trust Fund.

7.3.3 Support Development and Sustainable Use of Forests Outside of the Aberdares Conservation Area

A priority of ANRDP, Forest Department, and KWS should be to ensure that natural forests in Forest Reserves and on private land outside of, but near to (<10 km) the Aberdares Conservation Area are protected, well managed, and sustainably used, and that plantations and woodlots of exotic trees are considerably increased in size, number, and also better managed. This includes the reestablishment of natural forest or plantation on those lands of the Nyayo Tea Zone not planted with tea. The ANRDP should focus on enabling and encouraging the local people to meet their forest product needs from exotic tree plantations and from natural forest outside of the Aberdares Conservation Area. This activity would probably do as much as any to help maintain and expand a buffer zone for the Aberdares Conservation Area, thereby minimizing human pressure both on the Aberdares Conservation Area and on the wildlife fence.

7.3.4 Remove Encroachers

All encroachers should be removed from the Aberdares Conservation Area. Their continued presence undermines the future of the Aberdares Conservation Area and will limit the success of the ANRDP. The removal of all encroachers from this area should be a clearly stated objective of the ANRDP.

7.3.5 Protect Unfenced Forest

The extensive area of plantation in the Aberdares Conservation Area can serve as an important buffer to the natural forest. Since most of the plantation area will lie outside of the fence, there is concern that the plantations will be encroached upon and destroyed (Sections 6.4 & 7.2.15). It is not only critical that the plantations be protected, it is important that they once again be made productive. This should be one of the main goals of the ANRDP. This can be achieved by (1) stopping illegal activities on plantation land (including encroachment and grazing); (2) quickly replanting all plantations that have been harvested; (3) providing the necessary care to the growing trees (thinning, trimming, fire protection); and (4) permanently and clearly marking the boundary of the Forest Reserve, using the approach described in Section 7.2.15.

7.4 CRITIQUE OF FAO's 1997 ENVIRONMENTAL IMPACT ASSESSMENT OF THE ANRDP

In 1997, the Investment Centre of FAO produced a document titled Aberdares Natural Resources Development Project: Environmental Impact Assessment Report (FAO, 1997).

The team was to carry out "a detailed field review" and "a comprehensive environmental impact assessment" (EIA) of the proposed Aberdares Natural Resources Development Project (ANRDP). "The report is intended to provide the Government of Kenya and the African Development Bank with concise information about existing environmental conditions and potential environmental impacts which would result from project-supported investments and make recommendations designed to mitigate any potential adverse impacts." (FAO, 1997). The EIA team focused "...its efforts on assessing the environmental impact of the electric fence which was the primary investment proposed for reducing the level of human-wildlife conflict".

The findings, conclusions and recommendation of the present detail study differ from, and contradict, those of the FAO (1997) study on a number of critical issues. This report, therefore, finds it necessary to recommend that the FAO (1997) report be used with caution. When referring to the FAO report, the following should be kept in mind:

- Information vital to evaluating the information base on which the FAO report stands, and therefore the usefulness of its contents and recommendations, are generally not provided. For example, the report does not give information on the qualifications or level of experience of the team members, or on the places visited and studied. It seems that, overall, the team had little experience in Africa, virtually no expertise in the conservation of Afriomontane forest ecosystems, and examined but a small portion of the project area. The biggest constraint faced by the team was time. Only 3 weeks were given to work within Kenya and only a fraction of that was spent in the field in the Aberdares. This is simply not enough time to meet the objectives of this EIA...no matter how qualified and hard-working the team might have been. As a result, and contrary to what is claimed in FAO (1997), the report is not based upon "a detailed field review", "a comprehensive environmental impact assessment", or a detailed examination of the proposed fencing programme.
- It is important to note that the FAO report does not recognize two critical points as concerns the fence and the situation on the ground. First, the report does not recognize that the Aberdares Conservation Area is already an ecological island and that there is already a barrier around this island...a "human/agriculture barrier". The electric fence will

certainly have far less negative impact on the populations of plants and animals in the Aberdares, and on the ecological balance of this ecosystem, than does the current human/agriculture barrier. Second, the FAO report does not recognize that a successful physical barrier around the Aberdares ecosystem must not only keep wildlife in, it must be capable of limiting human access. Unsustainable and illegal utilization of the Aberdares Conservation Area are the most serious threats to this ecosystem. If a barrier cannot assist the management authorities in limiting human access to the Aberdares, then the barrier is doing less than half of the job that is required. This is why an electric fence is the best (probably only) option, and why a game moat is inadequate and should not be further considered.

- The FAO report often exhibits a surprising lack of perspective of the relative good or bad a particular activity causes. For example, numerous times we are told that fences are associated with erosion, and habitat destruction, or that they are unsightly. What the FAO report does not point out is that the amount of damage a fence might cause does not compare to the amount of damage people have caused both around and within the Aberdares Conservation Area, and how much more damage they will cause if the fence is not put in place. To construct a 300 km long fence along a 7 m wide cleared fence-line means that a total of 2.1 km² of habitat will be cleared. This is a minuscule area when compared to the many hundreds, perhaps thousands, of square kilometres of natural forest cleared in the Aberdares ecosystem for agriculture, the ca. 320 km² of natural forest and bamboo eliminated to establish plantations of exotic trees, or the 13 km² of natural forest that were recently cleared with ADB funds to establish the Nyayo Tea Zone.

The FAO (1997) report makes two important conclusions. First, it concludes that the initial project design placed too much emphasis "...on the electric fence as a physical barrier both for protecting the ecosystem and for reducing human-wildlife conflicts at its border." Second, it concludes that the electric fence should be only one element in a more comprehensive strategy to conserve the ecosystem, one that involves more community participation. This present study strongly disagrees with the first conclusion and fully agrees with the second.

8. DESCRIPTION OF THE PROJECT AREA

8.1 LOCATION

The Aberdares Range is located in central Kenya ($00^{\circ}00'S$ - $1^{\circ}00'S$, $36^{\circ}30'E$ - $36^{\circ}55'E$) and runs about 120 km in a NNW/SSE direction (Map 1). The maximum width of this range is ca. 40 km. The Aberdares Conservation Area (ca. 2,185 km²) is comprised of the Aberdares National Park (774 km²) and three forest reserves (1,411 km²). The forest reserves are the Aberdares (1,005 km²), Kikuyu Escarpment (367 km²), and Kipipiri (39 km²) (measured using 1:50,000 maps and Map-Info).

8.2 ADMINISTRATIVE SITUATION

The Aberdares National Park and the Aberdares Forest Reserves are located in the four districts of Kiambu, Muranga, Nyandarua and Nyeri, all of which lie within Central Province. Nakuru District (Rift Valley Province) abuts the Forest Reserve in the south-west. The perimeter of the Aberdares Conservation Area totals about 565 km, of which about 272 km are in Nyandarua District, 81 km are in Nyeri District, 46 km are in Muranga District, 146 km are in Kiambu District, and 20 km abut Nakuru District (Map 8).

8.3 GEOLOGY, ELEVATION AND TOPOGRAPHY

The entire Aberdares range has been subjected to intensive tectonic disturbances and subsequent volcanic activity associated with the formation of the eastern Rift Valley. The area's geology, topography, soils and drainage are reflection of these complex and diverse activities which were repeated both in the Miocene and at the end of the Tertiary.

The Aberdares are formed from basalt flows extruded onto Pre-Cambrian sediments. Although the Aberdares resulted from volcanic cones, they were initially formed from a lava sheet injected along a fault line of the Rift Valley. Subsequent weathering by high rainfall on the eastern side has produced a deeply dissected topography sloping gradually to the east. In contrast, land on the western side drops in a series of impressive fault escarpments to the floor of the Rift Valley. The highest peak (Oldonyo Lesatima) reaches 13,120 ft asl (4,001 m).

Elevation around the perimeter of the Forest Reserve varies between 6,500 ft (1,980 m) and 9,200 ft (2,800 m). The boundary of the Aberdares National Park ranges from 6,300-12,500 ft (1,920-3,810 m), with much of the boundary above 10,000 ft (3,050 m) (Map 5).

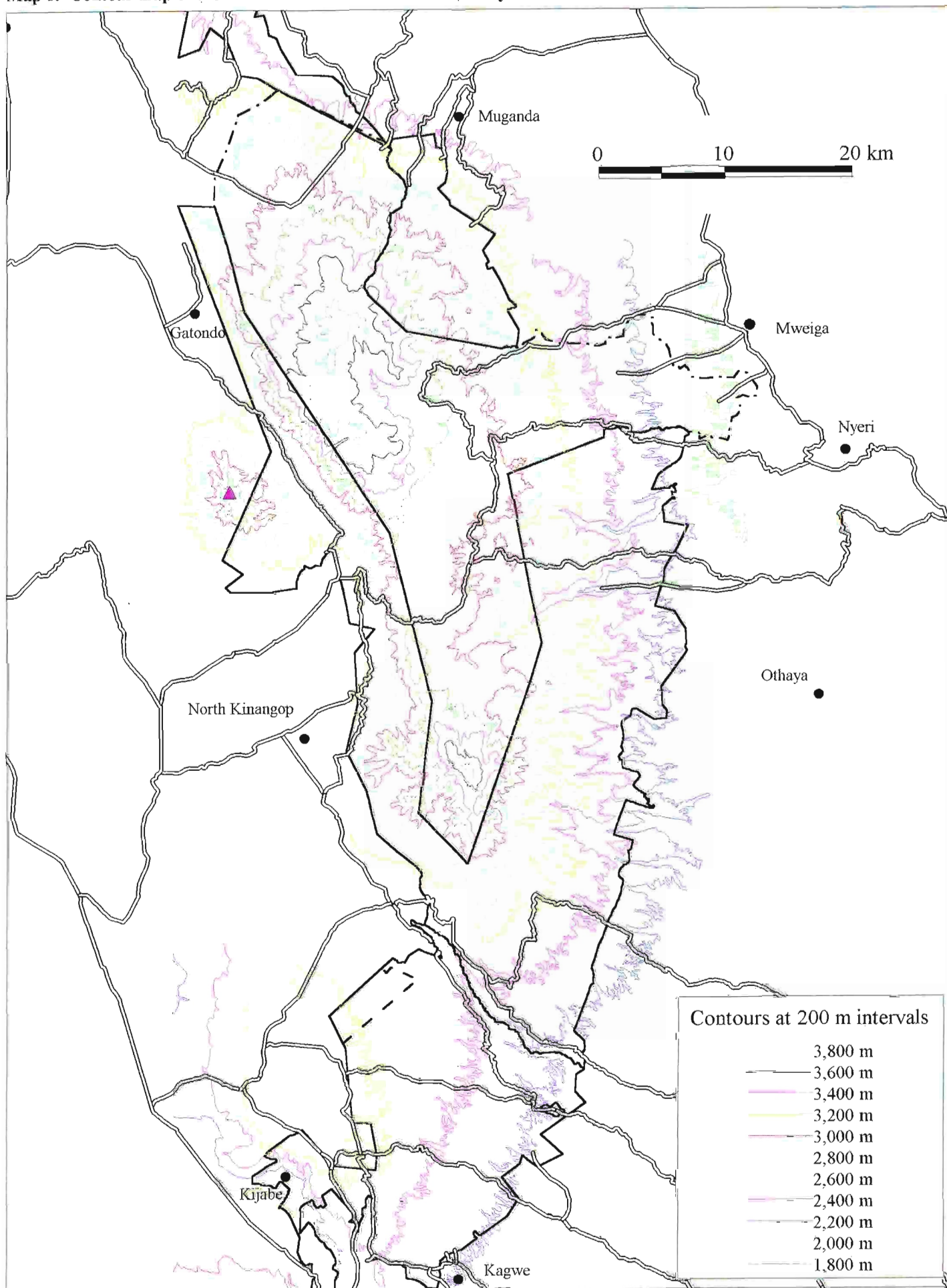
Table 3. Summary of altitudinal variation in the Aberdares Conservation Area, Kenya (Map 5). The Kipipiri Forest Reserve is excluded from this analysis.*

Elevation (feet) (meters)		Area (km ²)	% of total area
< 6500	< 2000	5	0.2
6500-7200	2000-2200	106	4.9
2200-7900	2200-2400	426	19.9
7900-8500	2400-2600	360	16.8
8500-9200	2600-2800	327	15.2
9200-9800	2800-3000	304	14.2
9800-10500	3000-3200	300	14.0
10500-11200	3200-3400	139	6.5
11200-11800	3400-3600	91	4.2
11800-12500	3600-3800	80	3.7
> 12500	> 3800	8	0.4

*Total area measured: 2,823 km².

From the stand-point of conservation, it is important to know those intervals of elevation which are most poorly represented in the Aberdares Conservation Area. Only ca. 5 km² of this area lie below 6,500 ft (2,000 m) and only ca. 8 km² are found above 12,500 ft (3,800 m) (Table 3, Map 5). Habitats at both extremes of elevation are likely to have species not found or uncommon in the remainder of the Aberdares Conservation Area. The area below 6,500 ft (2,000 m) is particularly rich in species and vulnerable. This area should, therefore, be given particular attention. The 111 km² (5%) of habitat below 7,200 ft (2,200 m) is also species-rich, yet already seriously degraded and vulnerable to further over-exploitation and encroachment. The 179 km² (8%) above 11,200 ft (3,400 m) are rich in regional (Afroalpine) endemics but reasonably well protected deep within the National Park.

Map 5. Contour map of the Aberdares Conservation Area, Kenya.



8.4 HYDROLOGY AND DRAINAGE

Together with Mt Kenya, the Aberdares range constitutes the main catchment area of the eastern Rift Valley highlands, and is one of Kenya's largest areas of heavy reliable rainfall. The steep slopes are drained by simple, parallel streams, flowing mainly to the southeast, north and west (Map 6). These streams feed four of Kenya's five drainage discharge areas: northern Ewaso Ngiro, Tana, Athi and Rift Valley catchments.

FAO (1994) states that "Water is probably the most important single product obtainable from the Aberdares." Most of the water supplies serving Nairobi and the surrounding districts derive from the Aberdares. In addition, the bulk of Kenya's hydro-electric power plants along the Tana River rely on water from the Aberdares, as do the irrigation schemes in Kiambu and Muranga Districts. If the forest cover of the Aberdares is destroyed the sediment load in the rivers will increase dramatically. This will cause numerous problems downstream (FAO, 1994). In addition, perennial streams will become seasonal, affecting domestic supplies to several millions of people.

8.5 SOILS

Soils of the Aberdares are basaltic in origin, derived from massive lava flows, volcanic buff and ash. Generally they are fertile and well drained, with high levels of organic matter in the upper layers. Soils rich in clay occur at the northern end of the Aberdares. The soils in and around the Aberdares Conservation Area are generally of moderately high fertility. Soils to the SW and NW of the Aberdares Conservation Area are of high fertility.

8.6 CLIMATE

The climate of the Aberdares is greatly influenced by the relief. At the northern end of the range, which has 3-4 dry months each year, the seasonal distribution of rain shows three peaks. These are in March-May (long wet season), July-August, and November. Elsewhere, rainfall is distributed bimodally with peaks in April-May and October-November, with only 1-2 dry months each year.

The eastern Aberdares have an equatorial climate, being wet and humid, with reliable annual rainfall of 1,400-2,200 mm and extended wet seasons (Map 7). On the western side, rainfall drops to ca. 1,200 mm/year at the forest border. According to Schmitt (1991), the wettest area lies at the southern end of the Park where rainfall is ca. 3,220 mm/year, while the driest area

is at the northern end of the Park where rainfall is ca. 940 mm/year.

As expected, temperature is closely related to altitude. Above 8,200 ft asl (2,500 m), frosts are common during July and August, and above 11,800 ft (3,600 m) nocturnal frost is common during all months. During the night, cold air moves down the slopes and under the warm air in the valleys, causing temperature inversions. As a result, valley bottom temperature are often 3-5°C colder than on the higher slopes. This phenomenon also results in strong local winds at night.

8.7 VEGETATION

8.7.1 Vegetation Zones and Types

The principal determinants of the distribution of the various vegetation belts, zones and types in the Aberdares are rainfall and temperature (Hedberg, 1951; Schmitt, 1991). Various authors have zoned the vegetation of the Aberdares in different ways. This report uses the zonation of Hedberg (1951) (Table 4). Because the fence will pass almost entirely through the "Montane Rain-forest Zone", this report further differentiates this zone into four types (Map 8). These are:

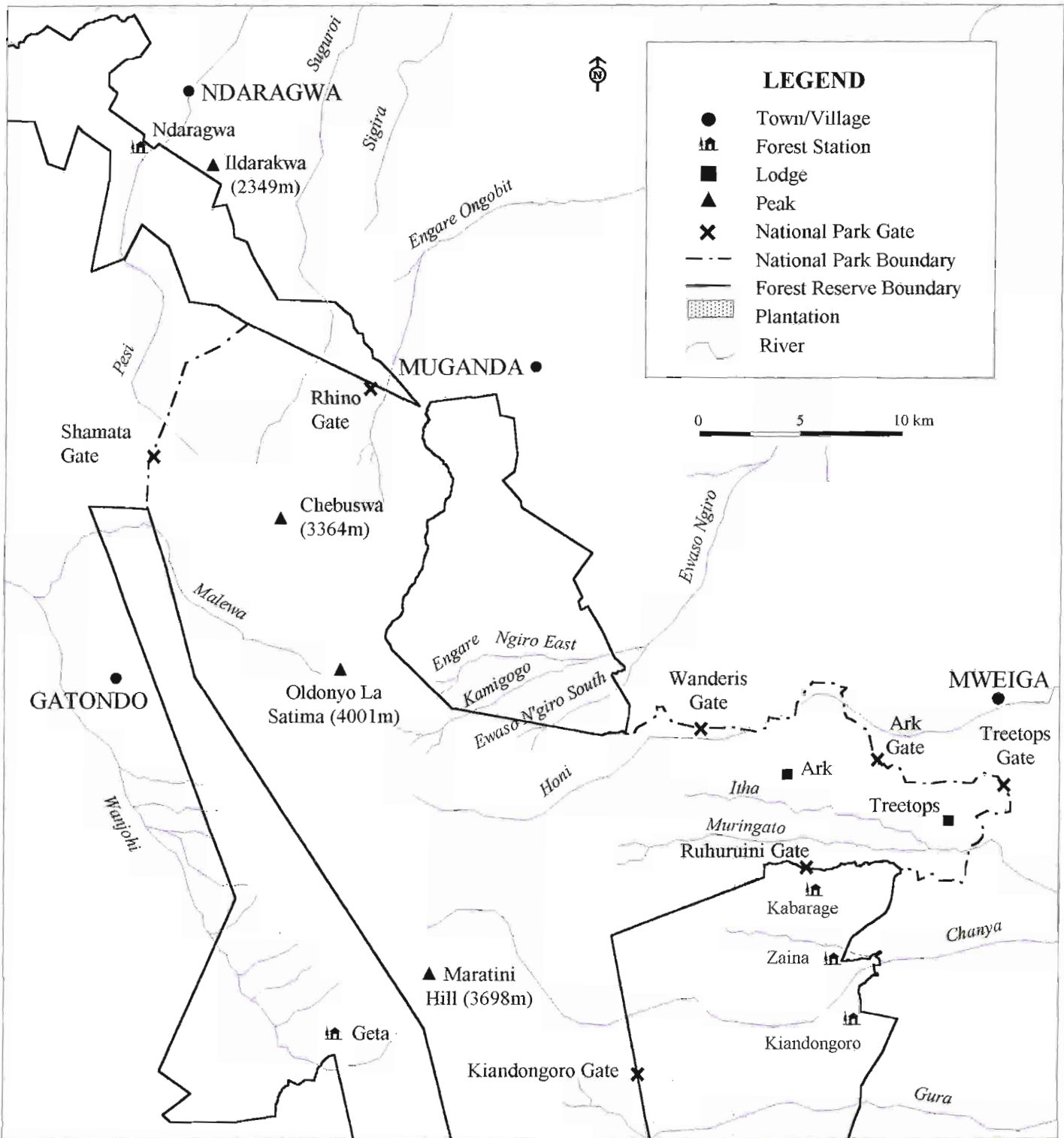
- Low altitude shrub
- Juniper/podocarpus/olive forest
- Drier evergreen forest
- Wetter evergreen forest

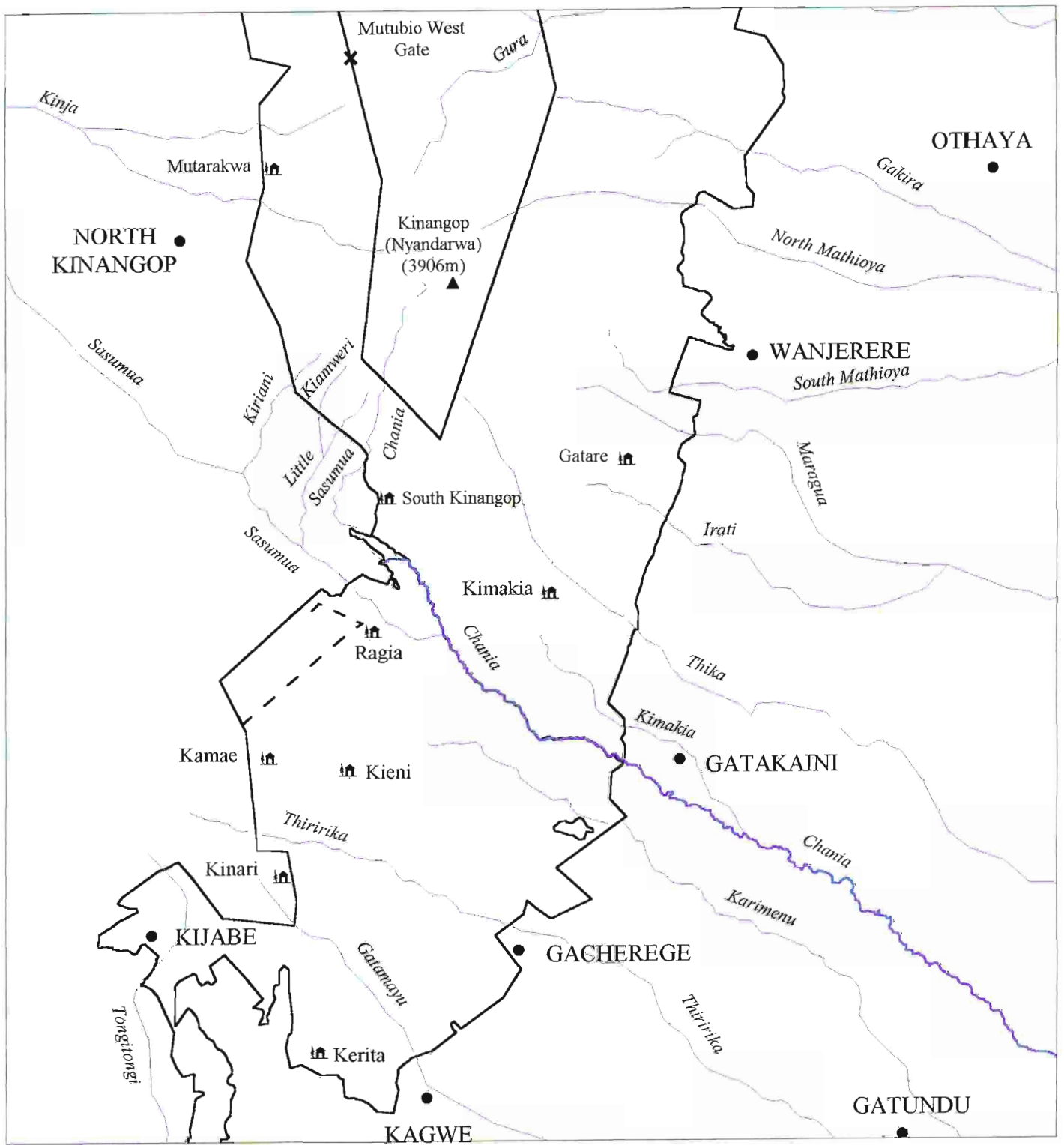
8.7.2 Vegetation Cover According to KIFCON (1994)

The information presented here on vegetation cover in the Aberdares Conservation Area is derived from two sources. It is likely that both sources applied the same set of 1990 aerial photographs of the Aberdares Conservation Area. The first source is a report by KIFCON (1994) (Table 5). The second source is the vegetation map of Nganga and Kamande (1990) which this study revised by overlaying the detailed distribution of plantations and encroachment as provided in 1998 by Forest Department on 1:50,000 maps (Map 8). Map-Info was used to digitized these 1:50,000 maps to obtain estimates of vegetation cover (Table 6).

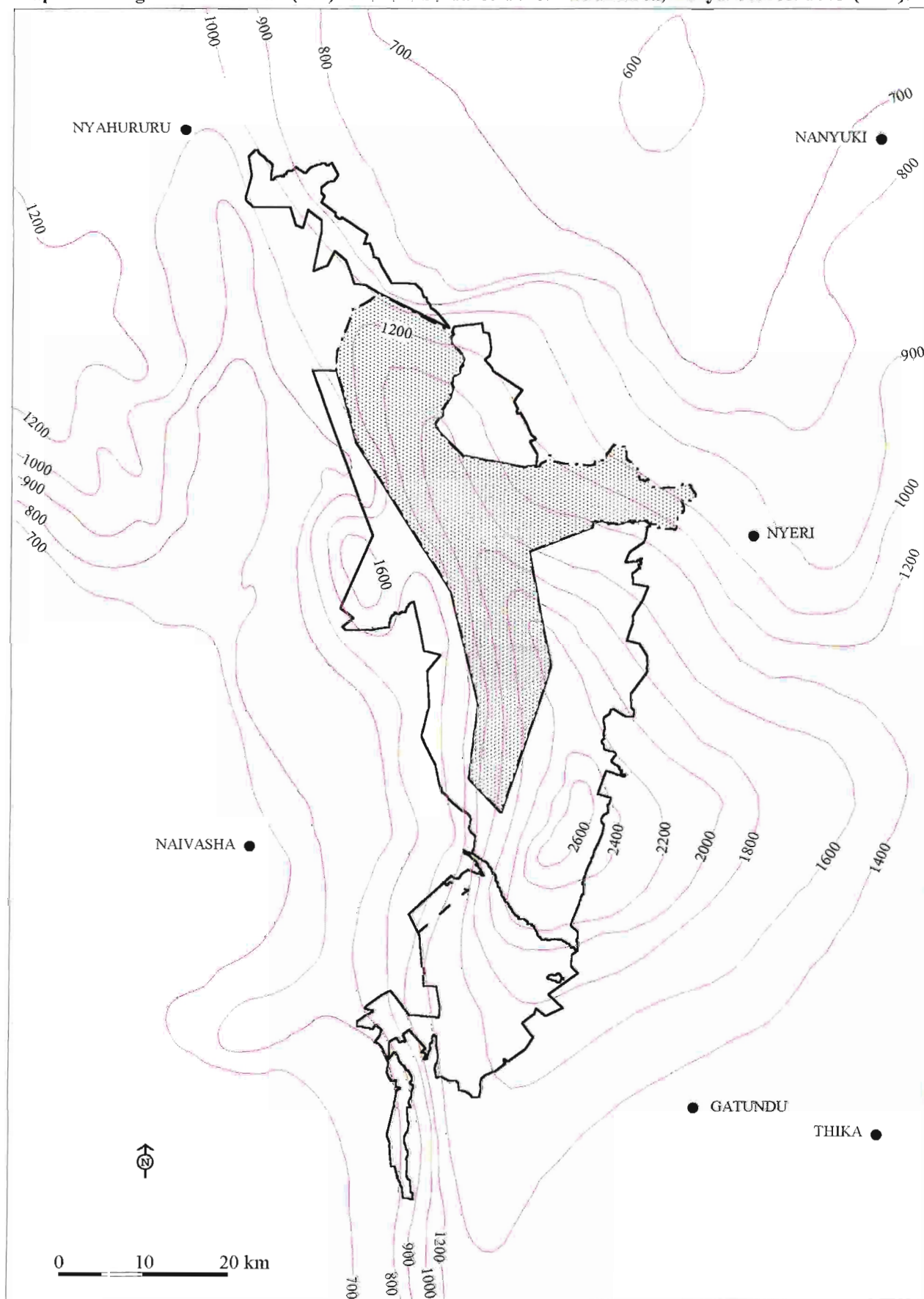
KIFCON (1994) assessed vegetation cover for the three forest reserves in the Aberdares Conservation Area (i.e., the Aberdares, Kipipiri and Kikuyu Escarpment Forest Reserves and excluded the Aberdares National Park). KIFCON found that in 1990, "closed natural forest" was the most extensive vegetation type, covering ca. 33% (459 km²) of the total forest reserve area (which KIFCON calculated to be ca. 1,460 km²) (Table 5).

Map 6. Main rivers and forest stations in the Aberdares Conservation Area, Kenya.





Map 7. Average annual rainfall (mm) for the Aberdares Conservation Area, Kenya. Source: FAO (1994).



Map 8. Distribution of vegetation zones over the Aberdares Conservation Area. Adopted from Nganga and Kamande (1990). See Table 4, 5 and 6.

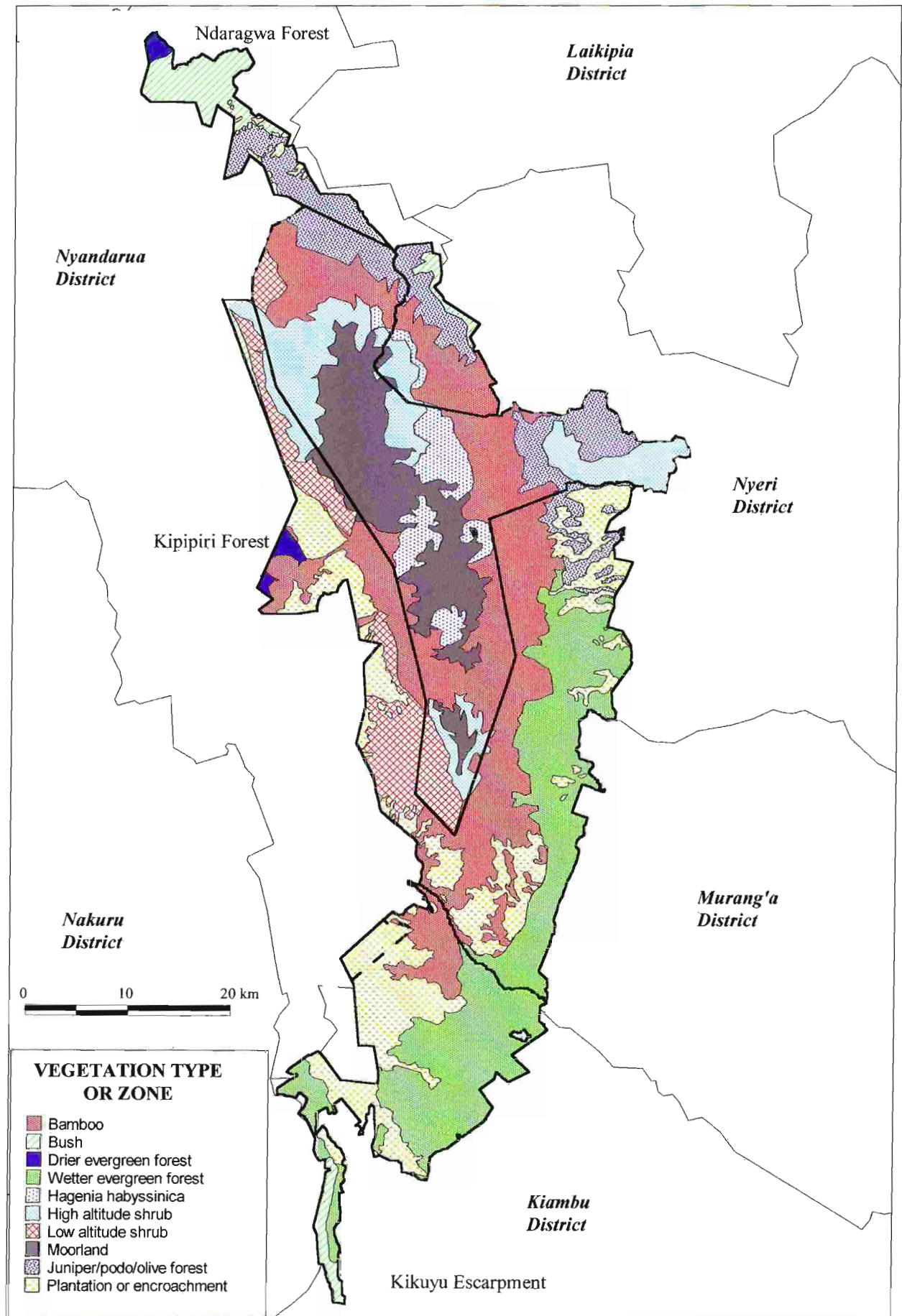


Table 4. Vegetation zones of the Aberdares ecosystem (Hedberg, 1951; Schmitt, 1991; Butynski, unpubl. data). See Map 8.

Vegetation Belt	Zone	Elevation	
		(metres)	(feet)
Montane Forest	Montane Rain-forest	1,600-2,400	5,200-7,800
	Bamboo (east slopes)	2,300-3,150	7,500-10,300
	Bamboo (west slopes)	2,600-3,300	8,500-10,700
	Hagenia-Hypericum	2,800-3,400	9,200-11,000
Ericaceous	Moorland	2,850-3,560	9,200-11,600
	Ericaceous-shrub	2,850-3,660	9,200-11,900
Alpine	Alpine	>3,650	>11,900

About 41% (596 km²) of the forest reserve area was covered with "other forest associations", 16% (ca. 239 km²) with "non-forest", and 11% (ca. 166 km²) with plantation.

In 1990, about 80 km² of the Aberdares Conservation Area was under cultivation or other non-forestry utilization. Most or all of this area was under illegal agricultural encroachment. "Presumed" legal Shamba System cultivation within exotic plantations is not included in this 80 km² figure. In 1990, presumed legal shamba cultivation in exotic plantations covered another ca. 23 km². Today, nearly a decade later, the Aberdares Conservation Area undoubtedly has an even greater area under agricultural encroachment and Shamba System cultivation.

8.7.3 Vegetation Cover According to this Study

This study used the distribution of vegetation types and zones presented on Map 8 and Map-Info to estimate the coverage of 10 vegetation zones and types in the Aberdares Conservation Area, within the National Park and three forest reserves, and inside of and outside of the fence as proposed in this report (Table 6).

Table 5. Area covered by different vegetation types in the three forest reserves of the Aberdares Conservation Area (i.e., Aberdares, Kipipiri and Kikuyu Escarpment Forest Reserves), Kenya, in September 1990. Note that the Aberdares National Park is not included here. Source: KIFCON (1994). See Map 8.

Vegetation Type	Coverage (km ²)	Coverage (%)
Closed Natural Forest	459	33
Montane Forest/Bamboo Mix	282	19
Bamboo	196	13
Exotic Tree Plantations	166	11
Forest/Scrub Mix	110	8
Moorland	49	3
Grassland	33	2
Scrub/Grassland Mix	27	2
Cultivated Land	65	4
Other (camps, infrastructures, stations, roads, <u>etc.</u>)	15	1
Total	1,460	100

The most extensive vegetation type in the Aberdares Conservation Area (ca. 2,185 km²) is bamboo (ca. 556 km², 25% coverage), followed by "wetter evergreen forest" (ca. 398 km², 18% coverage). Of the tree-dominated habitats, "drier evergreen forest" (ca. 12 km², <1% coverage) and Hagenia woodland (ca. 76 km², 3% coverage) are most poorly represented. Both areas of drier evergreen forest lie far outside of the proposed fence and close to human populations (Map 8). The conservation of this vegetation type should, therefore, be of particular concern to the ANRDP. In contrast, most of the Hagenia woodlands lie well within the National Park and are well protected.

Table 6. Area covered by 10 vegetation zones and types in the Aberdares Conservation Area, Kenya. Coverage estimates are based on the distribution of vegetation types and zones as presented on Map 8. Coverage was estimated using Map-Info.

Vegetation type	Inside fence coverage		Outside fence coverage		Total coverage	
	(km ²)	(%)	(km ²)	(%)	(km ²)	(%)
Bamboo	515	30	41	9	556	25
Wetter evergreen forest	350	20	48	11	398	18
Plantation or encroachment	89	5	235	52	324	15
Moorland	211	12	0	0	211	10
High altitude shrub	190	11	<1	<1	190	9
Juniperus/podo/olive forest	163	10	33	7	196	9
Low altitude shrub	126	7	14	3	140	6
Hagenia abyssinica	76	4	0	0	76	3
Bush	12	1	70	15	82	4
Drier evergreen forest	0	0	12	3	12	<1
Total	1,732	100	453	100	2,185	100

Of the ca. 2,185 km² Aberdares Conservation Area, about 1,861 km² (85%) is natural vegetation and approximately 324 km² (15%) is plantation or encroached upon. If the fence is placed as recommended in this report, about 1,643 km² (88%) of the natural vegetation of this Area will lie within the fence, while roughly 324 km² (73%) of plantation/encroachment will lie outside of the fence. This allocation is judged suitable for the long-term conservation of the Aberdares, and reasonable given all of the considerations and constraints.

While all of the Aberdares National Park (ca. 774 km²) will be within the fence, about 958 km² (68%) of the three Aberdares forest reserves will be within the fence and 453 km² (32%) will lie outside of the fence. Of the species-rich "wetter evergreen forest", about 350 km² (88%) will be within the fence and approximately 48 km² (12%) will lie outside of the fence.

The bamboo zone (ca. 556 km²) has certainly been reduced in area and degraded as a result of over-exploitation and conversion to agriculture. However, lying at a higher elevation than the wetter evergreen forest, and deeper in the Aberdares Conservation Area, this vegetation type has not suffered nearly as much as the wetter evergreen forest. The Hagenia woodlands (ca. 76 km²) and moorlands (ca. 211 km²), lying at the highest elevations in the Aberdares National Park, remain largely intact.

While the Aberdares Conservation Area supports one of the largest tracts of montane forest remaining in Kenya, it should be pointed out that (1) this is but a fraction of the area covered by montane forest prior to clearance by man, and (2) that this is the vegetation zone most under threat from farmers. In many places around the Aberdares, particularly to the south and east, closed natural forest must have extended down to below 5,900 ft (1,800 m) (for example, to Nairobi on the southeast side). Today closed forest is seldom found below 7,200 ft (2,200 m).

8.7.4 Tree Species Richness, Distribution and Abundance

Lists of plants known to occur in the Aberdares Conservation Area are provided in Nganga and Kamande (1990), Schmitt (1991), KIFCON (1994), Ng'oru (1998) and in Appendix II. Details on distribution and abundance of plants (particularly trees) of the Aberdares Conservation Area, as determined from sample plots, are provided in Nganga and Kamande (1990), Schmitt (1991), KIFCON (1994), Ng'oru (1998), and in Appendix II. Together, these sources provide ample baseline data for evaluating vegetation changes in the Aberdares Conservation Area, including vegetation changes relating to the impact of the wildlife fence.

The 10 most common species of trees in the three forest reserves of the Aberdares Conservation Area was determined by KIFCON (1994) (Table 7), while Nganga and Kamande (1990); and Tables 11 and 12 of this report provide similar information for various sectors of the Aberdares Conservation Area, including the National Park. This study sampled vegetation primarily at the lower elevations near the perimeter of the Aberdares Conservation Area (Map 18). The five most abundant species of trees are Nuxia congesta, Juniperus procera, Olea europaea, Podocarpus latifolius, and Neoboutonia macrocalyx (Table 11). This list is identical to that of Ng'oru (1998) who also

Table 7. The 10 most common species of trees (all size classes) in the three forest reserves of the Aberdares Conservation Area (*i.e.*, Aberdares, Kipipiri and Kikuyu Escarpment Forest Reserves), Kenya, in September 1990. Note that the Aberdares National Park is not included here. Combined, these 10 species accounted for 64% of the stems. Source: KIFCON (1994).

Species	Total stems	% of stems
<u>Neoboutonia macrocalyx</u>	1,093	14
<u>Macaranga capensis</u>	1,041	13
<u>Allophylus abyssinicus</u>	543	7
<u>Tabernaemontana stapfiana</u>	516	7
<u>Psychotria fractinervata</u>	514	6
<u>Podocarpus latifolius</u>	331	4
<u>Nuxia congesta</u>	282	4
<u>Clausena anisata</u>	267	3
<u>Dombeya torrida</u>	250	3
<u>Macaranga spp.</u>	230	3

conducted vegetation transects near the perimeter of the Aberdares Conservation Area.

8.7.5 Number of Plant Species and Endemic Plants in the Aberdares National Park

There are at least 774 species, subspecies and varieties of vascular plants within the Aberdares National Park. These belong to 423 genera and 128 families (Schmitt, 1991). The vegetation of the alpine and ericaceous belts of the National Park consists almost exclusively of species which are endemic or near-endemic to the Afromontane and Afroalpine Regions (*i.e.*, to the high mountains of East Africa) (Hedberg, 1986). The level of endemism drops rapidly as the elevation declines. Plants endemic to the Aberdares include Anemone thomsonii var.

friesiorum, Helichrysum gloria-die ssp. sattimae and Senecio keniensis ssp. brassiciformis (Hedberg, 1957).

A preliminary list of the rare and endemic species of plants in the Aberdares ecosystem is presented in Table 13. A list of the species of orchids found in the Aberdares, and which there is conservation concern, is presented in Table 14.

An inventory of the bryophytes of the Aberdares was conducted in 1993-94 found 124 species (Chuah-Petiot, 1997). These included six species new for Kenya. The greatest diversity of bryophytes was found in the wetter evergreen forest of the south and south-east Aberdares.

8.8 PLANTATIONS

8.8.1 Coverage

There are ca. 210 km² of exotic tree plantation in the Aberdares Conservation Area (Maps 2 & 8), roughly 135 km² of which are Cupressus spp. or Pinus patula. There are about 11 km² of Eucalyptus spp. In 1994, the area of clear-felled plantation that had not been replanted was approximately 40 km². Now, 5 years later, the area of unplanted plantation appears to be considerably greater. In 1994, 30% of the conifer plantation was over-mature (FAO, 1994).

FAO (1994) states that "Plantations have been established primarily in the bamboo belt...". This is not to be the case. Most of the plantations in the Aberdares Conservation Area lie just below the bamboo zone in the Drier Evergreen Forest and Wetter Evergreen Forest Zones, the two most species-rich vegetation zones in the Aberdares.

8.8.2 Excisions

There have been major excisions from the three Forest Reserves of the Aberdares Conservation Area. These excisions total ca. 5.6% (ca. 63 km²) of the former Forest Reserve area (KIFCON, 1994). The Aberdares Forest Reserve has lost 33.8 km² to excisions, the Kikuyu Escapement Forest Reserve has lost 18.8 km², and the Kipipiri Forest Reserve 10.9 km². KIFCON (1994) provides a detailed account of excisions from these three Forest Reserves. Also see IUCN (1996a).

8.8.3 Roads

There are ca. 1,100 km of roads in the Forest Reserves of the Aberdares at this time (Map 3). Of these, ca. 913 km are in plantations and 188 km are in natural forest. The vast majority of these roads are in poor condition, and the majority are

probably impassable. For example, in 1991, only 5.5 km of the 250 km of road in the Nyeri sector were maintained, and in the Muranga sector only 15 km of 187 km of road were maintained. During this study a large number of the roads through the Forest Reserves were not passable even with a short-wheel-base Land Rover.

8.9 BIRDS

8.9.1 Forest Birds

The Aberdares Conservation Area lies in the centre of Bird Atlas Square 62. Applying the list of "forest birds" for Kenya (Bennun et al., 1996), to the list of birds reported for Square 62 (0-1 S; 36-37E) (Bird Atlas Database, Ornithology Department, National Museums of Kenya, June 1999), there are 46 "forest-dependent" bird species known for the Aberdares (Table 18). These forest specialists "...are 'true' forest birds characteristic of the interior of undisturbed forest. They may persist in secondary forest and forest patches if their particular ecological requirements are met. Where they do occur away from the interior, they are usually less common. They are rarely seen in non-forest habitats. Breeding is almost invariably within forest." (Bennun et al., 1996). During this survey, 31 (67%) of the forest-dependent bird species were observed.

Similarly, there are 59 species of birds in the Aberdares Conservation Area that are classified as "forest generalists" (Table 18). These are species that "may occur in undisturbed forest but are also regularly found in forest strips, edges and gaps. They are likely to be commoner there and in secondary forest than in the interior of intact forest. Breeding is typically within forest." (Bennun et al., 1996). During this survey, 39 (66%) of the forest generalist bird species were seen.

Given the amount of research that has been conducted on birds in the Aberdares, the list of "forest birds" and "forests generalists" presented in Table 18 must be complete or nearly so.

The Aberdares Conservation Area supports the only forest of any size within Square 62. Therefore, it is safe to say that all 105 of these species of birds would be absent from the region, or very scarce within the region, if not for the forests of the Aberdares.

Not included among these 105 species are those species of birds dependent upon the non-forest vegetation zones of the higher parts of the Aberdares. That is, birds living in the moorland,

ericaceous-shrub, and alpine zones. These are poorly represented vegetation zones in Kenya, indeed, in Africa. Similarly, the species of birds dependent upon these vegetation zones are very isolated and often in small populations. The open habitats of the higher parts of the Aberdares are particularly important for the Aberdare cisticola Cisticola aberdare, Jackson's francolin Francolinus jacksoni, and moorland francolin Francolinus psilolaemus (see below).

8.9.2 Birds of Special Concern

The following is a summary on five species of birds for which the Aberdares are of particular importance for their survival. As species with small distributions, they are also the species that (1) bird tourists visiting the Aberdares are most anxious to see, and (2) that applied research and species management might focus on. The following information is taken from Collar and Stuart (1985), Taylor and Taylor (1988), Fanshawe and Bennun (1991), IUCN (1996b), and Zimmerman *et al.* (1996).

Jackson's Francolin Francolinus jacksoni. Confined to the Aberdares, Mt. Kenya, Mau Forest, Cherangani Hills and Mt. Elgon. Would be considered endemic to Kenya except for one record from the Uganda side of Mt. Elgon. On forest edge, and in bamboo and giant heath from 8,200-11,500 ft (2,500-3,500 m).

Moorland Francolin Francolinus psilolaemus. A near endemic species which is found outside of Kenya only on the Uganda side of Mt. Elgon. Confined to heath and grassland from 7,500-13,100 ft (2,300-4,000 m) on the Aberdares, Mt. Elgon, Mt. Kenya and Mau Narok. A scarce and little-known species.

Abbott's Starling Cinnyricinclus femoralis. Vulnerable (IUCN, 1996b). Occurs only on the Aberdares, Mt. Kenya, and Chyulu Hills of Kenya and on Mt. Meru, Ngurdoto Forest and North Pare Mountains of northern Tanzania. A little-known species which is generally scarce and local in forests from 5,900-8,200 ft (1,800-2,500 m).

Sharpe's Starling Cinnyricinclus sharpii. Occurs in the highlands of central and western Kenya, and of northern Tanzania. An uncommon species found in forest from 4,500-9,800 ft (1,400-3,000 m).

Aberdare Cisticola Cisticola aberdare. Kenya endemic with a very small range. Found only on the Aberdares and around Molo and Mau Narok in moist grasslands from 7,500-12,100 ft (2,300-3,700 m).

8.9.3 Rare or Uncommon East African Birds in the Aberdares

Listed here are four species of birds which are rare or uncommon in East Africa but which have been recorded within the Aberdares Conservation Area (Taylor & Taylor, 1988; Zimmerman et al., 1996).

Green Ibis Bostrychia olivacea. In Kenya only known from the Aberdares and Mt. Kenya.

Barred Long-tailed Cuckoo Cercococcyx montanus patulus. In Kenya only known from eastern Mt. Kenya and the southern Aberdares.

Red-chested Owlet Glaucidium tephronotum elgonense. One unconfirmed record for the southern Aberdares.

Orange Ground Thrush Zoothera gurneyi. Uncommon on several mountains in southern Kenya and northern Tanzania.

8.9.4 Census Method

Censuses of birds were conducted along transects. These transects were almost always located along roads within the Aberdares Conservation Area and, in most cases, in the vicinity of the proposed wildlife fence.

The method involved moving slowly along the transect for 15 minutes while recording all species of birds seen and/or heard. Date, time, location, altitude, and habitat type were recorded and a map of the location drawn on the data recording sheet. For each species of bird it was noted as to whether or not it was seen or heard within 20 m of the transect line. The observer moved along the transect as needed in order to find additional birds to identify. The distance moved during the 15 minute period varied from about 50 m (when birds were common) to about 200 m when birds were scarce. Most, but not all, censuses were conducted within 3 hours of dawn and dusk. All censuses were conducted by the author.

The above method is biased towards bird species of the middle story and canopy. Secretive species of the forest floor and understory were most likely to be over-looked. No mist-netting was conducted during this survey.

In addition to the 15-minute censuses, all species of birds identified during opportunistic observations (e.g., while driving, at camp) were also noted.

8.9.5 Results of Bird Censuses

A total of 1,252 records of 121 species were made during 158

15-minute bird censuses. The mean number of bird species recorded per transect was 7.9 (range = 2-16). As expected, the mean number of bird species per transect varied with the phase of the fence (Table 19).

In addition to the 121 species of birds recorded during censuses, 27 species were observed off of the censuses. Thus, this survey recorded 148 species of birds within the Aberdares Conservation Area (Table 20).

The abundance and altitudinal distribution of species of birds found during this study are summarized in Table 20.

Data on species of birds recorded along each phase of the wildlife fence are summarized in Table 21.

Table 22 lists the species of birds which were found in only one or two phases of the wildlife fence. These are considered to be species with limited distributions within the Aberdares Conservation Area. This table also lists birds which were found in seven or in all eight of the phases of the wildlife fence. These are species with wide distributions within the Aberdares Conservation Area.

A summary of the fence phase and elevation of each of the 158 15-minute transects is provided in Table 23, as is information on which species of birds were found.

It should be noted that two species of bird were found which are not on the 1999 list of birds provided by the Ornithology Department, National Museums of Kenya, for the Aberdares region (i.e., Square 62). These are the lead-coloured flycatcher Myioparus plumbeus (observed near the Honi River in the Salient) and the barred long-tailed cuckoo Cercococcyx montanus patulus, a species well known to occur in the southern Aberdares but somehow never placed on the Square 62 list.

During 1993-96, the author conducted bird surveys in the Aberdares Conservation Area, primarily in wetter evergreen forest of the Kieni and Gatamayu areas. During this work, 21 species of birds were recorded which were not detected during the 1997-98 Aberdares fence placement study. These 21 species are listed in Table 24. Of these, three are "forest-dependent" species and five are "forest generalists".

Table 25 lists those species of birds occurring within the Aberdares Conservation Area which, as yet, are only known from the northern (drier) or southern (wetter) half of the Area (i.e., north of 0.5 S and south of 0.5 S, respectively). Some of these species, such as the barred long-tailed cuckoo, brown-chested alethe Alethe poliocephala, and orange ground thrush Zoothera gunneyi require moist evergreen forest and are probably

absent from the northern Aberdares. Similarly, the southern Aberdares may be too wet and too well forested for such species as the African barred owlet Glaucidium capense.

One species requires special mention here; the mountain illadopsis Illadopsis pyrrhoptera. This species is listed in the Bird Atlas Database as occurring in Square 62, and I thought I heard this bird on two occasions. Yet, there seems to be no certain record for this species on the Aberdares or anywhere else East of the Mau Forest. Confirmation is, therefore, required.

With the wide range of altitudes and rainfall over the Aberdares Conservation Area, there are a large number of distinct habitat types within the Area, each with its distinct avifauna. In terms of importance for conservation, the two most unique avifaunas in the Aberdares ecosystem are associated with the moorlands and the wetter evergreen forest. The moorlands are well protected as they are located at the centre of the Aberdares National Park. The moorlands are also unsuitable for agriculture. The wetter evergreen forests, located primarily in the south and south-east parts of the Aberdares Conservation Area, represent both the most species-rich and most degraded and threatened vegetation type in the Aberdares.

8.10 MAMMALS

8.10.1 Overview

There are no fewer than 39 species of mammals in the Aberdares ecosystem which are the size of a hare Lepus sp. or larger (Table 26). A full inventory of the larger animals would probably bring the total closer to 50 species. Reports of 72 species of large mammals in the Aberdares Conservation Area (KWS, 1991; FAO, 1994, 1997) are incorrect, being based on a combination of error and on species "assumed" to be present. Those lists include species which certainly do not occur in the Aberdares ecosystem, including large-eared greater galago Otolemur crassicaudatus, patas monkey Erythrocebus patas, yellow-backed duiker Cephalophus silvicultor, and wild dog Lycaon pictus.

Of the species of mammals present, those of greatest conservation concern are Jackson's mongoose Bdeogale jacksoni, bongo Boocercus eurycerus, giant forest hog Hylochoerus meinertzhageni, and black rhinoceros Diceros bicornis. Wild dog Lycaon pictus have been reported to occur in the Aberdares but this species is no longer present. Golden cat Felis aurata are reputed to occur (Hardy, 1979; Watson, 1980). If present (which seems likely), this would be one of the few known localities for this species in Kenya. With a population of

about 2,500 elephants, the Aberdares are one of the more important sanctuaries in Kenya for this species.

8.10.2 Elephant Loxodonta africana

Endangered (IUCN, 1996b). In 1973 and 1977 there were an estimated 3,000 elephants in the Aberdares Conservation Area. In 1979, 1987 and 1989 the estimate was 2,000 elephants. A census of the Aberdares National Park (i.e., excluding the forest reserves), conducted in 1990, indicated that there were 1,800 (range 1,100-2,550) in the National Park alone (Blom et al., 1990). This is about 2.4 elephants/km².

Although Blom et al. (1990) concluded that the elephant population in the National Park seemed to be stable, the data suggest that the population increased between 1977 and 1990 as the National Park comprises only 38% of the area censused in 1973, 1977, 1979, 1987 and 1989 when the population was estimated at 2,000-3,000. This study found that elephants use, at least seasonally, nearly all of the Aberdares Conservation Area. Therefore, it would not be unreasonable to suggest that at least another 700 elephants lived in the 62% of the Aberdares Conservation Area not surveyed in 1990. If so, the total number of elephants in the Aberdares Conservation Area was at least 2,500 in 1990.

The most recent census of elephants in the Aberdares was conducted in 1998 using dung counts. The population was estimated at 4,120 with confidence limits of +/- 1,030 (MGM, 1999). Although the estimate is said to be for the Aberdares National Park (767 km²) and Aberdares Forest Reserve (996 km²), the total area given as covered by this census was reported to be only 1,030 km² (not 1,763, which is the combined area of this national park and forest reserve). It is extremely doubtful that there are 4,120 elephants in any 1,030 km² portion of the Aberdares Conservation Area, or even in the entire Aberdares Conservation Area (2,167 km²). I recommend that the 1998 dung count data and sample area be reexamined as the estimate of elephant number for 1998 appears flawed.

Based upon the available data, I suggest that the best estimate at this time is that there are between 2,000 and 3,000 elephants in the Aberdares Conservation Area. Whatever the actual number of elephants in the Aberdares, it appears that the Aberdares Conservation Area harbours Kenya's second or third largest population of elephants, surpassed only by the Tsavo population and possibly by the population on Mt. Kenya (MGM, 1999).

For convenience, this report loosely uses the term "population". In actual fact, the elephants of the Aberdares, Mt. Kenya, Laikipia, Samburu and adjoining areas are all part of the same population. This population probably numbers over 10,000

animals (MGM, 1999), making it one of the largest populations of elephants anywhere. Particular effort should now be given to ensuring that this population is not fragmented. In particular, there is the likelihood that within the next few years the sub-populations in the Aberdares and on Mt. Kenya will lose the corridors which connect them to the sub-populations in Laikipia and Samburu. This is a serious problem that needs to be addressed both nationally and internationally.

Historically, elephants probably moved in and out of the Aberdares ecosystem in all directions. A major migratory route from the Salient in the east central Aberdares towards Mount Kenya (Meinertzhagen, 1956) is no longer used as a result of the high human population in the region between the Aberdares and Mount Kenya, and the placement of a moat here during the late 1950s. Today, the only significant (and possible) movement of elephants in and out of this ecosystem is at the northern extreme of the Aberdares range via the Ndaragwa Forest and into Laikipia District (Sections 13.5 & 15.5) .

During this survey, elephant and buffalo dung counts were conducted along 31 transects located on roads throughout the Aberdares Conservation Area (Table 27, Maps 20 & 21). One count only was made along each transect. The total length of these 31 transects was 250.6 km (Table 28).

All dung piles located within 2 m of the centre of the road (i.e., 4 m wide strip) were counted. Elephant and buffalo often defecate while moving, scattering their dung. Dung scattered over the road that was obviously, or likely, produced during one "defecation event" was counted as one "dung pile". Size and age of the dung bolus were the main aids used to distinguish among dung piles. If any part of a dung pile fell within the 4 m wide strip, it was counted as one dung pile. Dung piles were counted by one observer while driving slowly along the transects. A second person recorded the number of dung piles, and kept track of the location and distance.

This rapid assessment method gives information on the distribution and relative density of elephant and buffalo over a large area with a minimum of cost and time. The data collected can be used to monitor gross changes in the distribution and relative density of elephant and buffalo over the long-term.

Elephants occur over nearly all of the Aberdares Conservation Area but their densities varied considerably from place to place. On average, 9.1 dung piles/km were found (Table 28). Elephant dung was absent from but two transects, both of which were located largely in plantations of exotic trees in the vicinity of the Mutarakwa Forest Station on the west edge of the Aberdares Forest Reserve. From Mutarakwa along the west edge of the Aberdares Forest Reserve to the Malewa River (Fence Phases 7

& 8) there is little evidence of elephants, although small numbers occasionally visit some sites (i.e., one to a few elephants present for brief periods every 1-3 years). The only exception is near the Mutubio Road where elephants move from the Park along the road and into the Forest Reserve and sometimes onto the farm land. The sheer cliffs (up to 600 ft or 180 m high) and steep, rugged terrain (rising nearly 2,200 ft or 670 m over 2 km) located to the east of this region must be in most places impossible for elephants to navigate. This is probably the main reason for the low density of elephants here. This is also, however, the biologically least rich part of the Aberdares Conservation Area and where farms reach farthest up the slopes (to 9,200 ft or 2,800 m).

Elephants reach their highest densities (28.3 dung piles/km) in the southern moorlands in the vicinity of Mutubio West Gate, Kiandagoro Gate, Karuru Waterfalls and Fishing Camp. Elephant densities were also fairly high (12.2 dung piles/km) in the Salient (Fence Phase 1).

8.10.3 African Buffalo Syncerus caffer

There are no estimates of the number of African buffalo in the Aberdares Conservation Area. This species is, however, widespread although at low densities in many areas in what is probably submarginal habitat for the species (e.g., closed bamboo, wetter evergreen forest, and juniper/podocarpus/olive forest).

Counts of buffalo dung piles were made along 123.5 km of road using the same methods as described above for elephant. One serious problem with this method is that it was not possible to differentiate between the dung of buffalo and that of cattle. Therefore, this method was not used when transects were located in the Aberdares Forest Reserve where cattle are widespread.

On average, 5.2 buffalo dung piles/km were found (Table 28). Buffalo are most common in the low altitude shrubland and open forest of the Salient (11.4 dung piles/km), but uncommon in the southern moorlands (0.8 dung piles/km).

8.10.4 Bongo Boocercus eurycerus

Near Threatened (IUCN, 1996b). The Aberdares is one of probably only three places in Kenya where bongo still occur. Kenya has an endemic subspecies of bongo, the mountain bongo B. e. isaaci. This subspecies is "endangered" (IUCN, 1996b). The Aberdares is thought to be the strong-hold for this subspecies, which has disappeared from much of its former range (e.g., Mt. Elgon, Cherangani Hill, Mount Loldiani) (East, 1988, 1998). Since 1978 there has been a considerable decline in the number of bongo in the Salient of the Aberdares (Hillman, 1983;

Cheffings, 1997). The bongo is seldom seen in the Salient (or anywhere else in Kenya) today. This decline appears to not have been limited to the Salient but has occurred through the range of the bongo in the Aberdares (Alan Root pers. comm., 1999, pers. observations).

It has been suggested and widely accepted that an increase in lions in the Aberdares, particularly in the Salient, has caused the decline of the bongo. Cheffings (1997) has shown, however, that lions were rare in the Salient until about 1986. At this time, the most likely causes of the decline of the bongo in the Salient are habitat change, disease or poaching, or a combination of these.

In the Salient, habitat change would seem to be the most important factor as the vegetation of the Salient has changed tremendously since the 1960s (Hillman, 1983; Schmitt, 1991; Cheffings, 1997) and hunting has probably been largely absent there. Elsewhere in the Aberdares the vegetation at the higher elevations has apparently changed little. If, however, bongo seasonally used and depended upon vegetation types at lower elevations (e.g., wetter evergreen forest during the dry months) they would have been greatly affected by the large scale removal during this century of all natural vegetation types over the lower elevations.

Alan Root (pers. comm., 1999) said that bongo were common in the Aberdares during the 1950s. He recalls that his company live trapped 28-30 bongos on three hills in the vicinity of the South Mathioya River (south-east Aberdares) in the late 1950s, and that two other trappers (Donald Hunt and John Sieman sp?) each live-trapped and removed about five bongo. He estimated that between 40 and 50 bongo were live-trapped in the Aberdares. These all came from a few localities covering a small part of the range of the bongo in the Aberdares. This removal of bongo is unlikely to have had much impact on the status of this population.

Alan Root and several authors suggest that poachers, using dogs or wire traps, are the primary cause of the decline of the bongo throughout Kenya. Bongo were readily brought to bay by dogs and then speared.

Disease might have been partly responsible for the decline. It is unlikely, however, that disease alone has prevented Kenya's populations of bongo from recovering from the decline which occurred near 20 years ago.

A brief survey of the bongo in the Aberdares was conducted in 1994-95 by Musyoki (1995). Bongo were still present in the north part of the Salient, in the bamboo east of Kiandongoro Gate, and on Kanjwiri Hill in the north Aberdares. Bongo were

reported to occur in a few other areas, such as south of Elephant Peak in the southern extreme of the Park, but this was not confirmed. Bongo were found in the Hagenia-Hypericum Zone, Bamboo Zone, and drier evergreen forest and shrub of the Salient. Bongo seemed to prefer the Bamboo Zone. Despite the considerable decline in the numbers of bongo in the Salient since the late 1970s, Musyoki concluded that the Salient still appeared to have the highest density of bongos within the Park. Herds of 6-21 bongo were observed during his study.

Bongo were not observed during this study. This is not surprising given that most of the work was done in habitat which is probably not suitable for bongo. Tracks of bongo were, however, found near the Honi River in the Salient.

8.10.5 Common Eland Taurotragus oryx

There are reports that eland were once common in the moorlands of the Aberdares. This is not the case at present. Eland were not seen during this survey but are known to occur in the Salient and in the region of Rhino Gate in the northwest part of the Aberdares National Park. The size of this population is probably small. Eland may need to be actively managed if they are to continue to survive in this Park. See below under "Plain's Zebra".

8.10.6 Plain's Zebra Equus burchelli

Only two zebra were found during this survey. Both were in the vicinity of Rhino Gates. This area is apparently the stronghold for this species within the Aberdares National Park. This isolated population is probably small and may require active management if it is to survive. While neither the zebra nor the eland are species threatened with extinction, these two large mammals are major components of the ecosystem of the northern part of the Aberdares National Park, of considerable interest to tourists, and probably important prey species for lion and spotted hyaena. Steps should be taken to prevent their extirpation from the Park. A census of these two species is long over-due. It is recommended that a census be undertaken simultaneously for the eland and the zebra as they occur in the same habitat in the same part of the Aberdares National Park.

8.10.7 Giant Forest Hog Hylochoerus meinertzhageni meinertzhageni

The giant forest hog is a species that is in decline throughout its range (d'Huart, 1993). In Kenya this pig is present in several scattered populations. As the largest of the world's species of pig, the giant forest hog is an attraction to tourists. One of the best places to view the giant forest hog was the Salient. This species has, however, experienced a

severe population decline in the Salient. This decline mirrors that of the bongo (Section 8.10.4). The decline of the giant forest hog in the Salient is likely the result of habitat change or disease (of which rinderpest is the most likely candidate), or a combination of the two. This species was not observed during this study.

8.10.8 Black Rhinoceros Diceros bicornis

Critically Endangered (IUCN, 1996b). Kenya's populations of black rhinoceros declined from an estimated 20,000 in 1970 to a mere 400-450 in 1989. There were about 40 black rhinoceros in the Aberdares National Park in the early 1990s (KWS, 1991). Most of the black rhinoceros then, as today are in the Salient, with a few individuals in the Shamata (northern) part of the Aberdares. This species was, however, once abundant throughout the moorlands. One of the main reasons for fencing the Salient was to create a sanctuary for the black rhinoceros (Kuhle, 1989). The fencing of much of the remainder of the Aberdares Conservation Area should also bring protection to the moorlands and complete the establishment of one of Africa's largest and most secure sanctuaries for this critically endangered species.

8.10.9 Lion Pantera leo

The lion population is believed to have increased considerably in recent years, although there is no scientific or documented support for this (KIFCON, 1992). This increase is suspected to have affected the numbers and distribution of several prey species, including the giant forest hog, bongo, eland, buffalo and black rhinoceros (MPANP, 1991). Lions are believed to have been introduced to the Aberdares but this is uncertain and is a point of debate.

8.10.10 Jackson's Mongoose Edeogale jacksoni

Vulnerable (IUCN, 1996b). This is a little-known species for which there are but a few records from the Aberdares and south-eastern Uganda. In the Aberdares it is known from high up in the bamboo zone of the Kinangop Plateau. The Aberdares National Park is the only protected area in which this species is known to occur. This National Park may be key to the survival of this species (Schreiber et al., 1989).

8.10.11 Olive Baboon Papio anubis neumanni

Much attention has been given by KWS to the olive baboon and the ability of the Aberdares wildlife fence to limit the access of baboons to crops, particularly maize. This survey found, somewhat surprisingly, that the distribution of the baboon is restricted to shrubland and to open juniper/podocarpus/olive forest in the fence Phases 1, 2 and 3 areas (Map 22). The

baboon appears to be common throughout the Salient (Phase 1), but is at low densities in the fence Phases 2 and 3 areas where it seems to be limited to the edge of the Aberdares Conservation Area. This species in the Aberdares is found only in the driest (annual rainfall <1,400 mm) areas. Baboons were observed from 6,300-8,100 ft (1,900-2,500 m), but there were reliable reports that they are present at Shamata Gate (9,100 ft, 2,800 m). The estimated range of the baboon in the Aberdares Conservation Area is roughly 177 km².

8.10.12 Sykes' (Kolb's) Monkey Cercopithecus albogularis kolbi

Sykes' monkey is present over a large part of the Aberdares from 6,300-9,400 ft (1,900-2,900 m), being most common in wetter evergreen forest. This species is found all along the perimeter of the Aberdares Conservation Area and apparently throughout the montane rain-forest zone (Map 23). Its range in the Aberdares is nearly identical to that of the guereza. The subspecies of Sykes' monkey found in the Aberdares is endemic to the Aberdares, Mt. Kenya, and Nairobi forests. There are certainly several thousand Sykes' monkeys in the Aberdares Conservation Area. The number might be well over 6,000. The range of this species within the Aberdares Conservation Area is approximately 1,050 km².

8.10.13 Vervet Monkey Cercopithecus aethiops

The vervet monkey was not observed during this study, but there are reliable reports that it is present in the woodlands of the lowest parts of the Salient. Elsewhere around the Aberdares the habitat is too well forested, too high and/or too wet for this monkey.

8.10.14 Guereza (Black-and-White Colobus) Colobus guereza kikuyuensis

The guereza is probably the most common monkey in the Aberdares Conservation Area. The observed altitudinal range was 6,300-9,400 ft (1,900-2,900 m). This species appears to be distributed throughout the montane rain-forest zone (Map 24), and seems to reach highest densities in areas where the tree Nuxia congesta is particularly common. Guereza are also fairly common in juniper/podocarpus/olive forest, a vegetation type in which Sykes' monkeys are relatively uncommon. This species and the Sykes' monkey have very similar distributional ranges within the Aberdares Conservation Area where the two are often found in polyspecific associations. Based on the number and location of calling (roaring) adult males, it is estimated that the density of groups of guereza is often greater than four/km², and that in some areas there are probably more than 10 groups/km². It would be surprising if there were fewer than 10,000 guereza in the Aberdares Conservation Area. This subspecies is endemic to the

Aberdares, Mt. Kenya and Ngong regions. The range of the guereza in the Aberdares is estimated to be 1,050 km².

8.10.15 Garnett's Galago Otolemur garnetti kikuyuensis

The Garnett's, or small-eared greater galago, was only heard and/or seen at two sites in the Aberdares (Map 25). One site was at 6,900 ft (2,100 m) and the other at 7,900 ft (2,400 m). That this species was not encountered more frequently in the Aberdares Conservation Area is somewhat surprising. This galago is probably at low densities in the Aberdares, but more widespread than the data indicate. It may be that Garnett's galago is a somewhat seasonal caller and that its calls relatively infrequently at the time of year when most of the survey work was conducted (February-April). This species seems to be far more common in lower elevation, secondary, evergreen montane forest, such as around Nairobi (6,100 ft, 1,900 m). This subspecies is endemic to the Aberdares, Mt. Kenya, Ngong and Nairobi regions.

8.10.16 Southern Tree Hyrax Dendrohyrax arboreus

Tree hyrax were heard at several widely scattered sites in the Aberdares Conservation Area (Map 25). This species was particularly common in the Salient, at Rhino Gate, and at Shamata Gate, but was also found in the southern and western parts of the Aberdares. The tree hyrax is found from 7,400-9,200 ft (2,200-2,800 m) within the Aberdares Conservation Area. This species is common at 6,000 ft (1,800 m) in the Nairobi forests (which lie at the southern extreme of the Aberdares ecosystem).

8.10.17 Ochre Bush Squirrel Paraxerus ochraceus

Squirrels were surprisingly uncommon in the Aberdares. The only species of squirrel observed during this study was the ochre bush squirrel. This species was seen at only four widely spaced sites: Park Sub-Headquarters in the Salient (8,000 ft, 2,450 m), near Wanderis Gate in the Salient (8,300 ft, 2,500 m), Bathi-Gatamayu Road (7,700 ft, 2,350 m), and Gatamayu Fishing Camp (7,500 ft, 2,300 m). This is, by far, the most common species of squirrel in the Nairobi forests (6,100 ft, 1,850 m), where it is sometimes abundant.

8.10.18 Red-legged Sun Squirrel Heliosciurus rufobrachium keniae

In addition to the ochre bush squirrel, probably the only other tree squirrel found in the Aberdares is the red-legged sun squirrel. This species was not seen during this study but has been observed by the author in the Gatamayu Forest. The red-legged sun squirrel seems to be at very low densities in the

Aberdares and may be confined to the wetter evergreen forest of the southeast and south Aberdares. This subspecies is endemic to the Aberdares and Mt. Kenya.

8.11 HERPETOFAUNA

All of the information below on herpetofauna of the Aberdares Conservation area is taken from Spawls (1978, 1996), and from Spawls and Rotich (1997). The herpetofauna of the Aberdares is poorly known, particularly at the lower elevations. As of 1996, the number of species recorded for the Aberdares was as follows: 3-4 snakes, five lizards, and seven frogs (Spawls, 1996). Of these fifteen species, six are endemic to Kenya and two are near Kenya endemics, being known elsewhere only on the Uganda side of Mt. Elgon. Thus, the Aberdares Conservation Area is an important site for the conservation of Kenya's herpetofauna.

Montane (Hinde's) Viper Atheris hindii. This snake is endemic to the moorlands of the Aberdares and Mt. Kenya at elevations above 9,850 ft (3,000 m). This species probably has the smallest range of any poisonous snake in Africa.

Mt. Kenya Bush-viper Atheris desaixi. Endemic to Kenya. Known only from forests of Mt. Kenya and Nyambeni Range. Might occur in the Aberdares.

Kenya Horned Viper or Worthington's Viper Bitis worthingtoni. Endemic to Kenya. Found in Aberdares.

Kenya Side-striped Chameleon Chamaeleo schubotzi. Known only from moorlands of Mt. Kenya at >9,850 ft (>3,000 m). Might occur on the Aberdares.

Von Hohnel's Chameleon Chamaeleo hohneli. Endemic to several mountain ranges in Kenya and Uganda, including the Aberdares. Found 3,300- >9,850 ft (1,000- >3,000 m).

Mt. Kenya Hornless Chameleon Bradypodion excubitor. Known only from mid-altitude forests on Mt. Kenya. Might occur on the Aberdares.

Alpine Meadow Skink Mabuya irregularis. Endemic to Kenya and Uganda. Found >9,850 ft (>3,000 m) on moorlands of Aberdares, Mt. Kenya and Mt. Elgon.

Alpine Meadow Lizard Adolfus alleni. Endemic to Kenya and Uganda. Found 9,200 ft (>2,800 m) on moorlands of Aberdares, Mt. Kenya and Mt. Elgon.

Montane Tree Frog Hyperolius montanus. Endemic to Kenya. Known only from the montane marshes of the Aberdares and Mt. Kenya.

Richard's Tree Frog Hyperolius cystocandicans. Endemic to Kenya. Known only from the Aberdares, Nyambeni Hills, Limuru and Nyahururu.

De Witte's Sharp-nosed Montane Frog Rana wittei. Possibly endemic to Kenya. Known only from the Aberdares and Mau Escarpment.

Kinangop Puddle Frog Phrynobatrachus kinangopensis. Endemic to Kenya. Known only from Nairobi north to the Aberdares moorlands.

9. HUMAN POPULATION AND ITS SOCIO-ECONOMIC SITUATION

In 1994 there were ca. 46,000 house-holds within 3 km of the forest boundary FAO (1994). These are the "local community" and "local people" frequently referred to in this report. Many of these people have a strong and immediate interest in the well-being of the Aberdares Conservation Area.

Emerton and Mogaka (1994) conducted a socio-economic study of communities within 3 km of the existing or proposed fence-line. They selected six sub-locations for their study, including two in areas where the fence already existed (Thatha and Amboni in Nyeri District). Their survey highlights the considerable variability found among the communities around the Aberdares in terms of the socio-economic situation. An over-view of their findings is provided here.

Population density varied from 58 persons/km² in northern Nyandarua District, to 975 persons/km² in southern Kiambu District. The size of farms ranged from 1-8 ha. Agricultural systems varied according to elevation, rainfall and size of the farm, with perennial crops (e.g., tea, fruit) important mainly in the south-east. Milk production is an important contributor to household income in all areas. More than 80% of households keep dairy cattle.

Almost 60% of households surveyed in the unfenced areas obtained a high proportion of domestic fuelwood from the forests of the Aberdares, and 52% grazed livestock in the forest, particularly during periods of drought. Construction materials were collected from the forest by 43% of households. More than one-third of forest-adjacent households utilized water sources inside the forest, especially in dry seasons. Other activities included placement of bee-hives, harvesting of wild honey, collecting of medicinal plants and wild fruits, and the use of fibres for ropes, baskets and mats. Few households rely on the forests as the sole source of the above products, however. Nevertheless, for a significant proportion of the people who live within 3 km of the Aberdares Conservation Area, the forest remains a valuable extension to their natural resource base... particularly those people living in areas with a high human population density. The reliance on forest resources, at least for subsistence use, appears to decrease sharply at a distance of 1-2 km from the boundary, and in some places the level of dependence appears not to extend beyond the farm that borders the Reserve or Park.

The level and importance of illegal use of the forest is difficult to estimate. It is obvious, however, that illegal cultivation, logging, charcoal burning, and the taking of poles are important sources of income in areas abutting the Forest

Reserve, particularly among the landless and unemployed, and during times of household cash shortage. Communities bordering the National Park, however, are much less dependent on the forest. This is because the removal of forest products from the National Park was banned decades ago, laws protecting the National Park have been fairly well enforced, and the people have adjusted to this situation accordingly.

Emerton and Mogaka (1994) also examined the effect of the installation of the fence (Phase 1 Fence) on farming systems in two sub-locations. In Thatha, which is bordered by the Forest Reserve, exploitation of the forest continued, although to a lesser extent than before the fence was erected. Access was still permitted for the collection of fuelwood and grazing; the two most important forest resources for the local community. The Amboni sub-location borders the National Park. Due to vigilant patrols by KWS personnel, the removal of products from the forest had declined. Fuelwood collection was still allowed here, but not livestock grazing. Overall, households appeared aware of the need to develop alternative sources of forest products, but lacked the means to do so.

According to the 1989 population census (extrapolated to 1994), there are about 127,000 households in all sub-locations that abut the Forest Reserve or National Park. Of these, roughly 46,000 households live within 3 km of the border of the Forest Reserve or National Park. The average population density is approximately 270 persons/km². The annual population growth rate is about 3.5%. Almost 85% of the people are dependent upon farming as their main source of income.

Current extraction levels are not sustainable. With the continued growth in population predicted for the high potential areas adjacent to the forest, the pressure for land and income is expected to continue to increase.

From this socio-economic study, it appears that any programme intending to support forest-adjacent communities to reduce forest use must take a flexible and broad approach. Programme interventions should highlight fuelwood conservation, on-farm fodder, development of alternative supplies of wood and water, and conservation education. Concerning the long-term sustainability of fence, it is imperative that forms of collaborative management among Forest Department, KWS, and forest-adjacent communities be developed in relation both to utilization of forest and maintenance of the fence.

10. AGRICULTURE

10.1 FARMING SYSTEMS

The forest-adjacent areas of the Aberdares 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, tea and pyrethrum are the major crops. Dairying, and to a lesser extent sheep production, are other important sources of cash. See FAO (1994) for detailed information on this topic.

10.2 NYAYO TEA ZONE

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."

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. 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.

According to FAO (1994), as of 1993, 61.4 km² of natural forest had been cleared in various forest reserves in order to establish the Nyayo Tea Zone (some reports say 110 km² were clear-felled as of 1993). Of these, 21.5 km² (35%) were cleared but not planted with tea as it has since been determined that the climate and/or soil were not suitable for tea. In 1994 it was proposed that this land be planted in fuelwood plantations or indigenous trees.

Also, clearing of the natural forest has not been controlled. Rather than clearing to 100 m into the forest reserve from the

boundary as mandated, clearance has often been up to 500 m into the natural forest (including the Aberdares), and up to 2,000 m in some places, such as the Bungoma Forest Reserve) (MENR, 1994a; IUCN, 1996a). 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."

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."

Wairagu (1996) reported that the extent of the Nyayo Tea Zone in the Aberdares was as follows:

- Nyeri: 4.11 km² cleared and 4.02 km² planted.
- Muranga: 1.85 km² cleared and 1.75 km² planted.
- Kiambu: 7.15 km² cleared and 2.05 km² planted.

Thus, in the Aberdares, a total of 13.12 km² of the most species rich of the natural forest was cleared and 7.82 (60%) planted with tea. The remaining 5.30 km² awaits reafforestation ...well over a decade after being cleared. Today, these cleared areas are nothing more than poor pasture for the illegal grazing of livestock and an attraction for encroachers.

Other forest reserves have fared even less well under the Nyayo Tea Zone Project. For example, of the 16.83 km² of natural forest cleared in the forest reserves of the Mau/Transmara region, only 3.83 km² (23%) have been planted in tea (Wairagu (1996)).

The effectiveness of the Nyayo Tea Zone as a conservation tool in the Forest Reserves of the Aberdares appears to be very limited and highly questionable. KWS has concluded that tea has limited value as a "buffer" between natural forest and cropland.

During this study, many 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, poor management, wasted crops, wasted montane forest habitat, and wasted land indicates that this scheme is not meeting its objectives. Next to the wasteful destruction of 5.30 km² of natural forest, what is most worrying about the Nyayo Tea Zone Project in the Aberdares 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 Aberdares Forest Reserve. Many of these people, who are poorer than the resident farmers and probably landless, are no doubt now 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 been 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 protect the Aberdares Conservation Area.

The failure of the Nyayo Tea Zone in some areas blurs the boundary to the Forest Reserve, reduces the coverage of montane forest in the Aberdares ecosystem, reduces the amount of forest produce available to local communities, reduces the effectiveness of this critical watershed, and invites severe criticism of the Nyayo Tea Zone Development Corporation, Forest Department, the African Development Bank, and others who promoted, supported and implemented what appears to be an ill-advised, environmentally damaging project.

11. HUMAN-WILDLIFE CONFLICT

11.1 BACKGROUND

During the 19th Century there has been 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. Kenya is one of these countries. As human populations grow, the natural resources available to each individual 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, generally have high agricultural potential. As such, these forest zones have been more extensively destroyed than any other in Africa. This is extremely worrisome, both from the perspectives of biodiversity conservation and long-term human survival.

With extensive loss of habitat, populations of some species of wildlife (e.g., elephant) are compressed into increasingly small areas. 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 of the negative impacts of wildlife.

Elephant probably cause the most damage to crops and property around the Aberdares Conservation Area. Buffalo bush pig, baboon, Sykes's monkey, crested porcupine and various species of antelope can be locally important (Anon, 1991; Appendix I). The main food crops consumed or trampled by wildlife around the Aberdares are maize, beans, Irish potatoes and wheat. Lion, leopard, spotted hyaena and baboon sometimes kill livestock in and around the Aberdares, but this is not generally a serious problem.

While wild animals encroach upon and do damage to agricultural lands, livestock and exotic tree plantations, people illegally destroy the wildlife directly through poaching, or indirectly by degrading or destroying the habitat on which wildlife depends. Around the Aberdares, the pressure to illegally remove forest products, or to illegally destroy forest to establish agricultural plots is very high (Emerton & Mogaka, 1994; FAO, 1994; this study).

At this time, the pressures of certain species of large mammal on crops around Aberdares Conservation Area, 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 forests of the Aberdares, and to the movement of people into these forests, 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 the natural resources of the Aberdares is eliminated.

11.2 DAMAGE CAUSED BY WILDLIFE TO FARM HOUSEHOLDS

In 1992, KIFCON (1992) conducted a brief survey of the impact of wildlife damage on farm households adjacent to the Aberdares National Park in the region between Wanderis Gate and Rhino Gate along the NE edge of the Park. This ca. 15 km long sector is recognized as having an unusually high level of damage from wildlife and, therefore, a high level of human-wildlife conflict. The results of this survey are summarized here:

- Wildlife, particularly elephants, buffaloes, monkeys and wild pigs caused significant damage to crops and fencing, and lions, leopards and hyaenas kill livestock.
- Sixty-one percent of adjacent households suffered some damage to farm fencing during the previous year, while 31% lost crops, and 37% lost livestock. Some human lives were also lost.
- Overall, wildlife caused damage to at least 117 of the 192 households living within 1.5 km of the park boundary.
- Annual value of wildlife damage to these households might be up to KShs 3.8 million, or KShs 32,000 per household.
- Although most households took some preventative actions against wildlife, this was not enough to have a substantial impact.

The people here are relatively well off. Their farms average 22 ha in size (25.6 ha near the forest), and they own an average of 12 cattle and 37 goats/sheep. The main crops are maize, beans, wheat, pyrethrum, cabbages and potatoes. Over the last 26 years, two people have been killed by buffalo, one has been killed by an elephant, and one received a broken limb during an encounter with a buffalo. All were attacked while on their farms. Leopards and lions are the major threat to livestock, with spotted hyaenas less so. The 37% of interviewees who lost livestock in 1992, lost 10% of their livestock. See KIFCON (1992) for more detailed information on this subject.

This study (Appendix I) found that the level of damage to crops caused by wildlife varied considerably around the Aberdares Conservation Area, being most severe in the north (Phases 1, 2, & 3 areas), and least serious in the west (Phases 7 & 8 areas). Damage to livestock from wildlife was largely confined to the Phases 1, 2 and 3 areas.

11.3 KWS SUPPORT TO LOCAL COMMUNITIES

Under KWS's Community Wildlife Services programme, a portion of National Park gate receipts (about 9% in 1993-94, amounting to KShs 36 million) is set aside nationally for the use of communities, and at the discretion of the wardens in-charge of parks. In the Aberdares National Park, these funds have been used to improve local infrastructure, particularly in areas where the fence has been constructed. As of 1994, these funds had been used to construct or repair about 10 dams and more than 100 km of roads around the Aberdares.

12. CONSERVATION POLICIES AND AGREEMENTS

12.1 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.

12.2 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 upholding the principles at the highest political level (see IUCN, 1996a).

12.3 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. The Aberdares and Kikuyu Escarpment Forest Reserves are among nine Forest Reserves specifically mentioned for biodiversity conservation.
- 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.

12.4 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.

12.5 KWS/FOREST DEPARTMENT MEMORANDUM OF UNDERSTANDING

In 1991, KWS and Forest Department signed a memorandum of

understanding for the joint management of selected forest, one of which is the Aberdares Forest Reserve. 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.

12.6 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).

12.7 LOGGING OF INDIGENOUS TREES

Kenya's natural forest, perhaps particularly the forest reserves of the Aberdares, have been unsustainably logged. In 1986, a Presidential Decree banned the felling of indigenous trees. Nonetheless, the cutting of indigenous trees continues at a high and unsustainable rate in the Aberdares Conservation Area.

12.8 SHAMBA SYSTEM IN PLANTATIONS

Initially, the "Shamba System" (= "Taungya System") 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. 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 Forest Department. 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 by livestock, and agricultural encroachment (FAO, 1994; IUCN, 1996a). 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, 1994). Since that time, however, the Shamba System has been reinstated as a tool used by Forest Department for planting trees, although only "Non-Resident Cultivators" are allowed to practice the Shamba System in the Aberdares. Each Non-Resident Cultivator is licensed to cultivate an area for 3 years. The payment is KShs 220/ha/year. Importantly, the Non-Resident Cultivator cannot live in the forest reserve and has no guarantee either of employment or of obtaining another plot.

As of 1994, Forest Department reported 20.1 km² of plantation land under "legal" Shamba System in the Forest Reserves of the Aberdares (Emerton & Mogaka, 1994).

13. FENCE PHASE 1

13.1 BACKGROUND TO THE FENCE

Location. The Salient, east-central Aberdares, from Wanderis park gate to Ruhuruini park gate (Map 9).

Status. Fence construction completed in 1990.

Length. 39 km (measured on ground).

Purpose. To establish a black rhinoceros sanctuary within the Aberdares National Park, provide security to the habitats, wildlife and tourists of the Salient, and to significantly reduce the level of human-wildlife conflict in the region.

13.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use

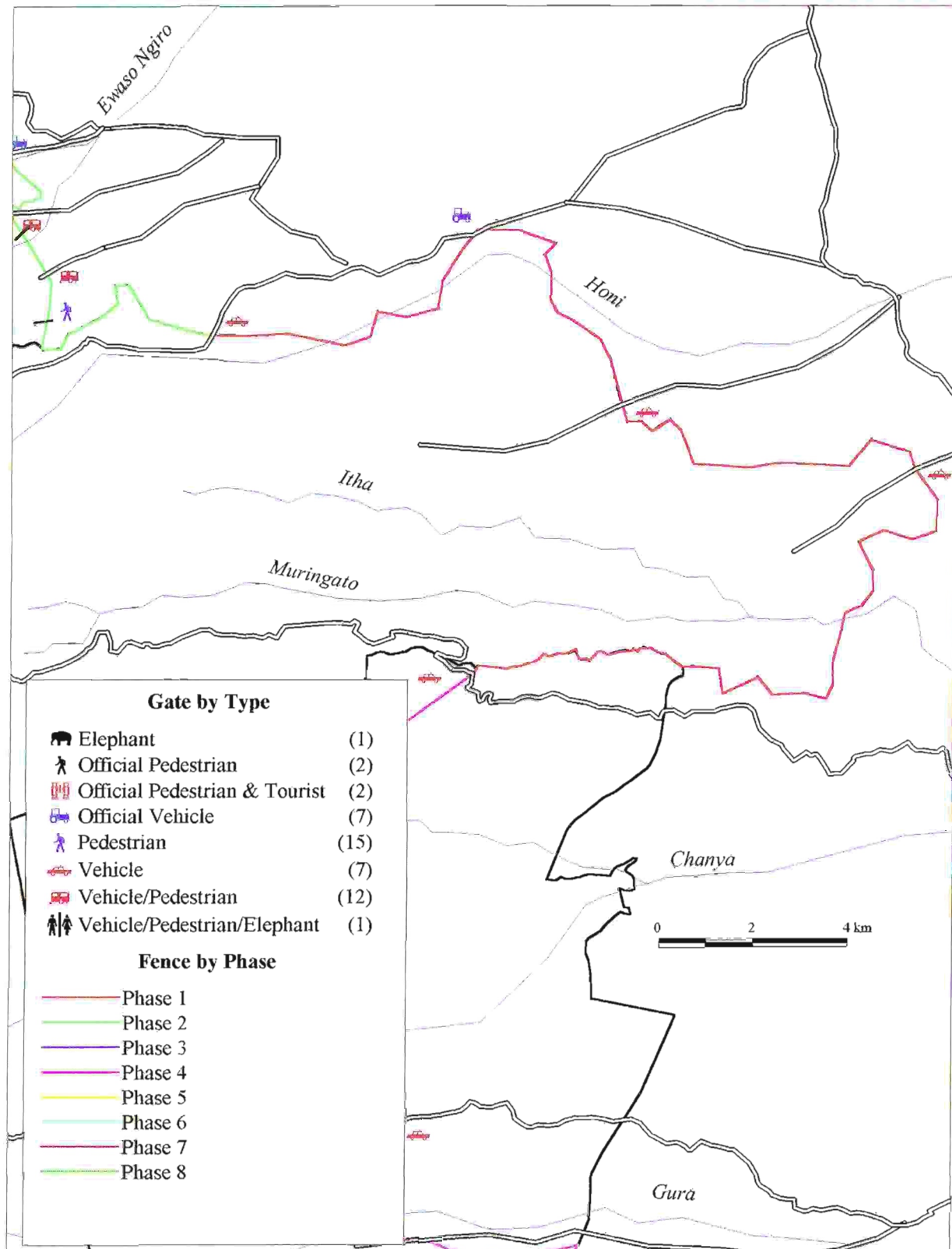
- Number of people interviewed: 37
- Population density near forest: relatively high.
- Mean size of farm plots: 2.8 ha
- Main crops: maize, beans, potatoes, livestock.
- Conservation Area: Park abuts the farmland. Forest Reserve absent.

Crop and Livestock Damage. At the time of this survey, the fence was in place for 6 years. Seventy-three percent of the people interviewed said damage to their crops by wildlife had declined a lot as a result of the fence (Appendix I). Past serious damage to crops by elephant, buffalo and antelope, but these species no longer a problem. There has been a considerable decline in loss of livestock to lion, leopard and hyena. Farmers no longer needed to protect their crops and livestock at night. Damage to crops from baboons, Sykes' monkeys and porcupine remained a concern.

Past and Current Use of the Natural Forest. Prior to the fence there was illegal taking of forest products and poaching within the Salient (Schmitt, 1988). These illegal activities have essentially stopped with the erection of the fence.

Attitudes Towards the Fence. All but one of the 37 farmers interviewed was happy with the fence, even though few were informed or consulted about the fence by KWS prior to its

Map 9. Recommended location of the Abardares Conservation Area Phase 1 fence and gates.



construction. Due to the fence, large mammals seldom cause crop damage. The local people living close to the Phase 1 fence are very positive about the fence as it has greatly decreased the amount of damage to crops, livestock and infrastructure, and lessened the need for constant vigilance. People noted both a change to the quality of their lives and an improved ability to produce more and better crops. The fence has, therefore, done much to reduce the level of human-wildlife conflict among communities living along this 39 km stretch of the Aberdares National Park. Since people here were not permitted to take forest products prior to the construction of the fence, the fence is not denying law abiding people of products that they once had access to. People here see the fence as providing them with financial and social benefits. They also reported that the fence throughout is well maintained, and that any damage to the fence is quickly reported and repaired.

The seven rangers interviewed believed that the fence was a good conservation tool and that the local people were supportive of the fence. They, however, suggested that stronger materials should be used to build the fence, that more community involvement with the fence was needed, and that the fence should be constructed to prevent medium-sized mammals from getting through.

One year after the construction of the Phase I fence, KWS (Munai, 1991) stated "It has proved to be effective in the protection of wildlife and their habitats. It has acted as a good deterrent to wildlife invading the local population and their properties. This includes both large and small animals (e.g., elephants, lion, buffalo, bushpigs, porcupines). The response of the community and local leaders has been very positive towards this development." This study found nothing to contradict this assessment.

13.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. Flat to hilly (Map 5). This is one of the most gentle regions of the Aberdare ecosystem. The Amboni (Honi) and Muringato are the two major rivers in the Salient. Both rivers flow to the east. The Phase 1 fence and, therefore, the edge of the National Park and the forest lies between 6,300 and 7700 ft. This is one of the lowest areas along the perimeter of the Aberdares Conservation Area. Soil fertility in this area is moderately high.

Rainfall. Mean annual rainfall here is ca. 1,000 mm at 6,300 ft and ca. 1,400 mm at 7,700 ft (Map 7).

13.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. The Salient is covered largely by two vegetation types. These are "Low Altitude Shrubs" and "Hagenia Forest" (FAO, 1994) within the "Montane Rain-forest Zone" (Hedberg, 1951). The vegetation of the Salient is described in detail by Schmitt (1988, 1991). The Salient holds the only submontane forest within the Aberdares National Park. The forest here has been much disturbed by man and wildlife, especially towards the lower margins and along the boundary of the Park. Before the area was gazetted as part of the Aberdare National Park in 1950, it was a Forest Reserve and tree and bamboo cutting, grazing of livestock, agriculture and poaching were common. This disturbance was reduced by the creation of the Park, but was never completely abolished (Schmitt, 1991), continuing up to the time of the fence. Today, the Salient is comprised largely of disturbed forest and of about 25 km² of dense secondary bushland which has replaced submontane forest. There are also small areas of bamboo, riverine forest and grassland. The bamboo zone begins at about 7,500 ft. One of the Aberdares' rarest trees is found in the Salient, Polyscias kikuyuensis.

During this survey, 33 species of trees were found along 19 tree belt-transects (Appendix II). The five most common species of trees here are Olea europaea (13% of stems), Teclea simplifolia (11%), Cassipourea malosana (11%), Nuxia congesta (10%), and Podocarpus latifolius (10%). The five most common species of trees accounted for 55% of the stems along the 19 tree transects. With a mean of 6.8 species of trees per transect and 42.9 stems per transect, the richness and density of trees here was intermediate when compared with the other seven phases of the fence.

Plantations and Excisions. None.

Birds. Sixty-five species of bird were observed during the 17 censuses undertaken in the Phase 1 area (Table 21). The mean number of species seen per census was 8.9 (Table 19). No particularly rare or unusual species of birds were seen here, although some lower elevation, drier country birds were found here which may not be present elsewhere in the Aberdares (Table 22). These include the scimitarbill Rhinopomastus cyanomelas, northern ant-eater chat Myrmecocichla aethiops and lead-coloured flycatcher Myioparus plumbeus. Golden-winged sunbird Nectarinia reichenowi and green pigeon Treron calva were common, as were flocks of red-fronted parrots Poicephalus gulielmi.

Large Mammals. The Salient probably supports the highest biomass of large mammals of any site in the Aberdares (Schmitt, 1991). Elephant, buffalo, waterbuck, suni, spotted hyaena, leopard, lion and black rhinoceros are common here (Appendix

IV). Giant forest hogs are also present. This is the most important area in the Aberdares for the conservation of the black rhinoceros, with at least 45 individuals present. At one time this was the place in Kenya to see bongo. This is no longer the case as the bongo is today a rare species in the Salient, if not in all of the Aberdares ecosystem. The primates here are olive baboon, Sykes' monkey, vervet monkey, guereza, and Garnett's galago. This is the part of the Aberdares Conservation Area where baboons are most common, and the only place where vervet monkeys occur.

The Salient was part of a major migratory route for elephant leading from the Aberdares apparently to Mt. Kenya. With the loss of habitat in the intervening valley, establishment of dense settlements, and construction of a game moat in the 1950s (Woodley, 1965), the route was effectively destroyed, although elephants still occasionally moved out of the park here and into the Nyeri Forest Reserve and neighbouring ranches. With migration off the east-central side of the Aberdares no longer an option, elephants grow in numbers in the Lower Salient during March, April and May (long wet season) of each year as they move down from the moorlands and bamboo zones. This seasonally high concentration of elephants in a small area has contributed to the destruction of forest around Treetops lodge and to a considerable expansion of the area covered by grassland.

13.5 THE FENCE

Placement. The completed Phase 1 fence lies at the Park/farm plot interface all along its length (Map 9). This is the most suitable location for this fence. No changes in the location of the Phase 1 fence, or in the location or number of gates are recommended by this report.

Infrastructure and Gates. Five vehicle gates allow ready entrance to this part of the Park where there are 130 km of good road in an area of less than 70 km². With two game lodges and nine camp sites, this is the region where much of the Park's tourism is concentrated. There is also a vehicle track all along the fence-line. The ready access to this fence, together with the fairly gentle terrain, make the Phase 1 fence fairly easy to monitor and maintain. There are no pedestrian gates as no taking of forest products is allowed within the Phase 1 fence. The posts of the Phase 1 fence are of juniper (= cedar) or treated eucalyptus (gum). The design of this fence changed as its construction progressed. In the later stages, wire mesh was placed below the ground to deter burrowing mammals such as warthog and porcupine. Some "primate electric wire loops" were also installed but these proved to be ineffective against baboons and Sykes' monkeys.

Positive Impacts.

- Proven high level of protection for habitats, wildlife and tourists within the Park, and for people, livestock and crops outside the park. Although the fence has been broken at least 40 times by elephants since its construction (20 times in 1996 alone), these breaks were quickly repaired. Breakage is expected to occur less and less frequently as "traditional knowledge" among this elephant population is lost, as what little natural habitat that remains outside of the Conservation Area is reduced, as the area becomes more densely settled by people, and as artificial mineral licks are established within the Conservation Area (see below).
- The fence effectively established Kenya's second sanctuary for the black rhinoceros.
- Considerable reduction in the level of human-wildlife conflict and improvement in community-KWS relations.
- That part of the elephant migration corridor between the moorlands of the Aberdares and the eastern end of the Salient appears secure for the foreseeable future.

Negative Impacts.

- Although the migration corridor for elephants from the Aberdares to Mt. Kenya had already been lost as a result of settlement and habitat destruction outside of the park, the fence effectively prevents elephants from moving along any part of the traditional corridor which might remain outside of the Park. In any case, there is no part of this corridor outside of the Park that elephants could use prior to the construction of the fence (say, during the late 1980s) without coming into considerable conflict with farmers.
- Although the vegetation of the Salient is extensively modified by the past activities of man, it continues today to be modified, or prevented from recovering, by the unusually high concentrating of large mammals, particularly elephants.
- There is serious soil erosion in places along the fence (e.g., north of the Honi River).
- Herbicides were initially used in maintaining the cleared area along the fence. This practice has, fortunately, been abandoned.
- About 60 elephants are outside of the Salient to the east in the Sangare Ranch/Thebo Forest/Nyeri Forest region. These animals will not now be able to enter the Aberdares ecosystem without removing a portion of fence.

Mitigation Measures and Recommendations

- A priority for conservation of the Aberdares ecosystem in the Phase 1 area to ensure that there is good management of those natural forests which lie to the east of the Phase 1 fence. In particular, the Nyeri (ca. 9 km²), Nyeri Hill (ca. 2 km²), Kiganjo (ca. 3 km²) Forest Reserves. Together, these three natural forests comprise an area of ca. 14 km². Proper management and sustainable use of these Forest Reserves would do much to meet local needs for natural forest products and, thereby, help keep pressure off both the fence and the natural forest of the Aberdares Conservation Area. ANRDP and KWS should assist Forest Department in this effort. It is also vital that the large area of exotic tree plantations off the south side of the Salient be protected and made as productive as possible.
- Further evaluate the feasibility of reestablishing the elephant migration corridor between the Salient and Mt. Kenya, or at least of reestablishing the corridor linking the Salient to the Nyeri Forest (ca. 2.7 km off the east end of the Salient) and perhaps to Sangare Ranch (ca. 3 km to the northeast of the Salient). The main problems here are that there are thousands of farmers in the area and little natural habitat. There is, however, considerable interest among conservationists in further evaluation of this situation.

Concerning elephants and migration routes between the Aberdares and Mt. Kenya, it is important to make two points. The first point is that whatever migratory routes might have existed for elephants between the Aberdares and Mt. Kenya, elephants probably did not generally move more quickly or in a straight line from one mountain range to the other (as some people seem to envision). Rather, the movement of elephants here was probably out of these mountains onto the valley floor where they foraged for weeks or months during the wet months before returning to the mountains. This would, of course, be unacceptable today to local farmers. Near some protected area, such as the Shimba Hills National Reserve, local people gave up land so that elephants could move more readily between sites. This is not likely to happen in the area between the Aberdares and Mt. Kenya as conditions for agriculture are far better here than at Shimba and the number of people that would have to move is much larger.

The second point is that populations of elephants on Mt. Kenya and in the Aberdares may still exchange individuals (at least occasionally) via northern routes through Laikipia/Samburu (MGM, 1999). It appears that the only remaining route for elephants out of the Aberdares and into Laikipia at this time lies at the northern extreme of the Aberdares. The priority activity in the region for the conservation of the

elephant should be to ensure that this corridor, the Ndaragwa Corridor, remains open (Section 15.5).

- Examine the feasibility of translocating some of the ca. 60 elephants in the Sangare Range/Thebo Forest/Nyeri Forest region to the Aberdares.
- The local people should take more responsibility for limiting damage to their crops by baboons, Sykes' monkeys and porcupines. These three species are widespread in Kenya and cause damage to agricultural crops far from protected areas. Baboons are the most serious crop pest in Kenya. Patrols of the fence by the affected farmers (or by someone jointly hired by them) and their dogs at those times of the day and year when raids by these species are most likely to occur can be very effective. Sticks, stones, catapults, noisemakers, etc., can be used with success.

There are two reasons why KWS should not be overly concerned with crop damage by primates around the Aberdares. First, damage by primates today represents but a small fraction of the wildlife damage that farmers experienced prior to construction of the fence. Prior to the building of the fence, primates were fifth and tenth on the list of most significant pest species along the Aberdares in the Nyeri and Nyandarua Districts, respectively (Anon, 1991). In both Districts, elephant, lion, leopard and buffalo were all considered more important pests than primates. That primates are now viewed as the most significant pest is a tribute to the effectiveness of the fence in reducing crop and livestock damage by wildlife. Secondly, further reducing damage to crops by primates by fencing would be very expensive and certainly not cost-effective. KWS has more important matters to spend its time and money on, and cannot be expected to solve all of the problems of the local people. Where primates are a particular problem, trapping or shooting are likely to be the most effective means of curtailing crop damage.

- The fence needs to be reinforce, if not up-graded, in places (e.g., in the vicinity of Rhino Gate).

13.6 COMMENTS

- FAO (1997) states that there are "Mixed community attitudes towards the fence. Sense of ownership does not appear to be as high as reported by Rhino Ark and Zoo Atlanta, particularly among women". It should be noted that (1) FAO (1997) presents no data to support this statement, and (2) that it is doubtful if the FAO team spent nearly enough time in the Phase 1 area to obtain a useful sense of what the communities' attitude towards the fence was.

- While the fence may somewhat reduce damage by primates to crops, it is not an effective barrier. At this time there is no cost-effective "primate fence" that could be constructed in the Aberdares. As such, if primate damage is to be further reduced, it will have to be by means other than a primate-proof fence. Where the problem is most serious, KWS might reduce the primate pest problem by trapping and/or shooting; otherwise it is up to the local farmers to do what they can to limit this damage. This report suggests that the current fence has already greatly benefited the local people, and that KWS should not be too concerned at this time with spending limited resources dealing with the primate problem along the Phase 1 fence. There are far more important conservation problems need to be addressed with these resources. Also, it should never be forgotten that the owners of land next to the Park bought the land at a discount, factoring in the various costs related to wildlife coming onto the land from the Park. As a result of the fence, many of these costs no longer exist or are greatly reduced.

13.7 CONCLUSIONS

The existing Phase 1 fence is, when all is weighed, an excellent conservation tool and probably excellent value for the money. Rhino Ark and KWS should be commended on this initiative.

14. PHASE 2 FENCE

14.1 BACKGROUND TO THE FENCE

Location. Northeast Aberdares, from Wanderis park gate to Rhino park gate (Map 10).

Status. Construction completed in 1994.

Length. 38 km (measured on ground).

Purpose. Reduce the level of human-wildlife conflict as crop-raiding by wildlife in this region was a serious problem. An equally serious problem was the illegal taking of the forest products, including agricultural encroachment over part of a vital watershed. The fence assisted greatly in the eviction of the encroachers and has served to prevent them from continuing to over-exploit either the Forest Reserve or the National Park.

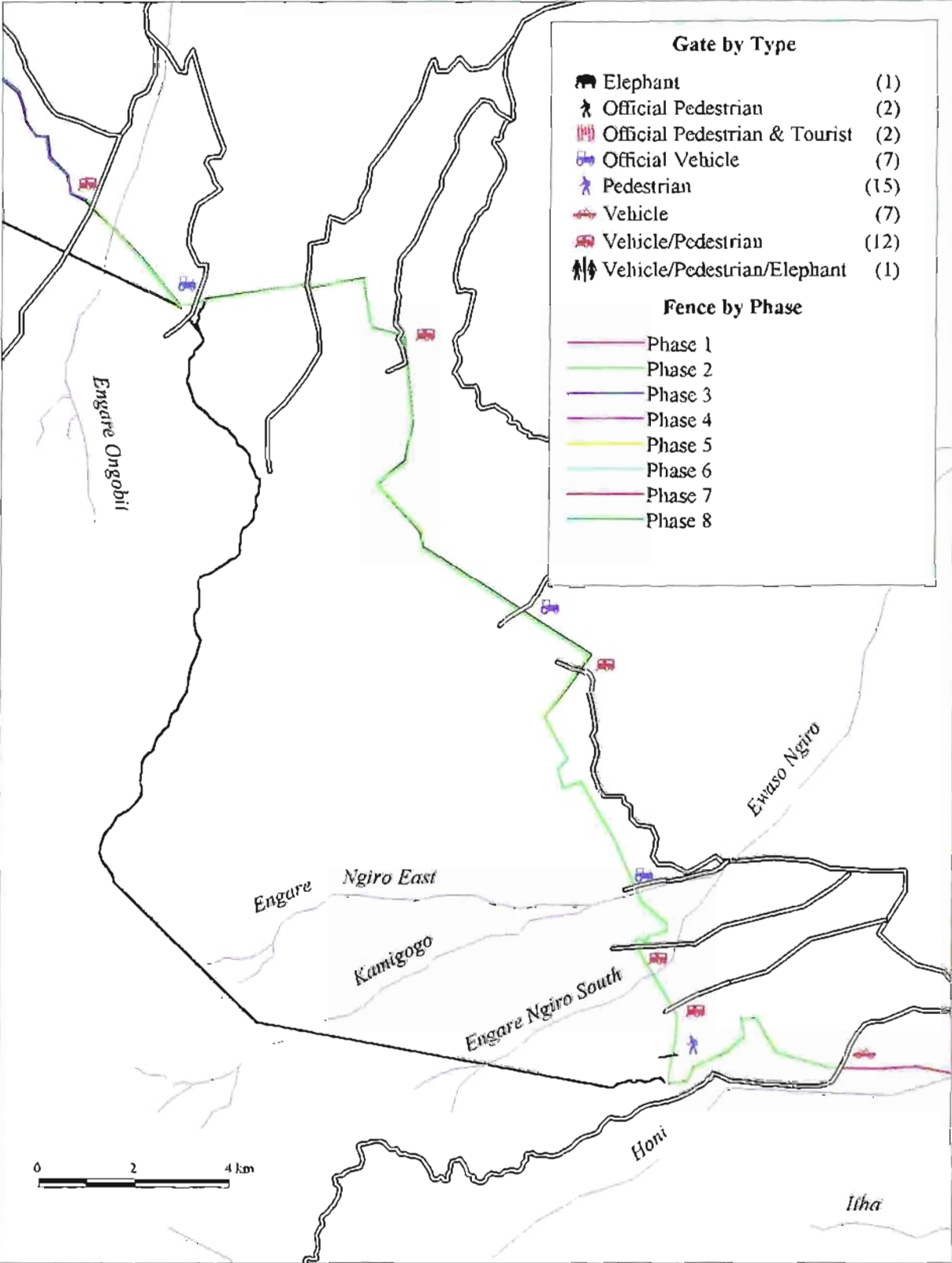
14.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use

- Number of people interviewed: 45 residents and seven evictees.
- Population density near forest: highly variable, from relatively low to relatively high.
- Mean size of farm plots: 2.4 ha in the Gakanga, Mugak, Kiambugo, Kaliki and Kiriogo areas, but 20 ha in the Embaringo, Belle View, and Watuka areas.
- Main crops: maize, cabbage, potatoes, beans, pyrethrum, wheat, livestock.
- Conservation Area: Farm plots against Park boundary for first ca. 3 km northwards from Wanderis park gate. Thereafter, farm plots against border of Forest Reserve.

Crop and Livestock Damage. In the past, elephants, buffalo, lion and leopard were the major problem species (Anon., 1991). Ninety-four percent of the people interviewed said damage to their crops by wildlife had declined a lot as a result of the fence (Appendix I). The fence has largely stopped elephants, buffalo, lion, leopard, hyena and antelope from coming onto the farmlands. Baboons are not very common here, perhaps the elevation is too high. Sykes' monkeys and porcupine are the most important crop pests at this time. Almost all of the residents who were interviewed said that experienced a

Map 10. Recommended location of the Abardares Conservation Area Phase 2 fence and gates.



substantial reduction in the loss of crops, livestock, and property to wildlife. The exception was people near Rhino park gate where the fence had just been completed and where the impact of the fence on the movement of large wild animals was yet to be felt.

Prior to the fence, the primary means of stopping wildlife from doing damage was to make fires, guard the crops and livestock, and pray.

Past and Current Use of the Natural Forest. Until the fence was constructed, there was extensive illegal use of the Forest Reserve, in particular agricultural encroachment. Agriculture, livestock grazing, timber and pole cutting, and the making of charcoal seem to have been the most serious problems prior to the construction of the fence. The Forest Reserve at Gakanga (also known as the "Karameno Triangle" or "Charity Area") was cleared of forest by encroachers, beginning in 1973. The "story" is that people were moved in 1971 from the Teso/Ruhuruini area as part of a resettlement scheme. They never received title deeds to the land at the new location, however, and their land was taken from them. Now landless, they encroached on the Forest Reserve in 1973 and destroyed ca. 3 km² of natural forest. About 600 families were evicted from the encroached area in 1994. People claim that Forest Department officials took money from them to let them encroach and to remain on the land. The surrounding forest was also degraded by the encroachers as there was apparently no control on the taking of forest products, including timber, poles and firewood.

The erection of the fence has allowed Forest Department to regain control of the area. People no longer live within the Forest Reserve at Gakanga. They are, however, allowed, under permit, to take livestock fodder, firewood from fallen trees, and timber from exotic trees in the former encroached area. A permit allows up to 750 kg of grass to be removed per month and 90 head-loads of firewood. The monthly permit for grass costs KShs 180. It costs KShs 970 to remove a 5 tonne truck load of grass, and KShs 1,200 for a 5 tonne truck load of firewood. At Gakanga the vehicle gate is open on Monday, Wednesday, Friday and Saturday from 10:00 h to 17:00 h. The Manoro pedestrian gate is open from 8:00 h to 15:00 h. Fifty-eight people have permits to enter the Forest Reserve to collect grass or firewood at Manoro, 68 at Gakanga Gate, 109 at Kamenda Gate, and four at Rhino Gate.

At least 60% of the people interviewed said they make a lot of use of the Forest Reserve for fuelwood, and more than half of them claimed they obtain fodder for livestock from the Forest Reserve.

Many of the farms had some pasture and small woodlots. The larger farms usually had substantial areas of pasture and sizeable woodlots. Sizeable areas of valuable natural forest remains on some of the larger farms.

Gates were sometimes manned, but often we found gates open with nobody from Forest Department or KWS manning them. For example, during three visits to the Manoro pedestrian gate there was no Forest Guard present. Nonetheless, the gate was open and people were passing through, some with fuelwood or fodder.

Attitudes Towards the Fence. About one-thirds of the people interviewed said they had received information and/or had been consulted about the fence prior to its construction. This was primarily during workshops organized by KWS and Forest Department to which all interested parties were invited to attend. The majority of the residents were pleased with the fence, especially those who had lived in the area for some time and who had farms. People in the Mugaka and Kiambogo areas were generally unhappy as the gates in the newly constructed fence here were not yet open. Many people in the Kaliki area near Rhino gate were displeased because they lived near the end of the unfinished fence and the fence was apparently causing elephants to spend additional time on the croplands as they searched for a route around the fence to the Forest Reserve. This area lies on an elephant migration.

The evictees were generally displeased with the fence as most of those who had remained in the area were now residing on borrowed or rented 0.1 ha plots. While some agreed that the fence is serving a valuable purpose, all would prefer to have been left to cultivate land within the Forest Reserve. All claim that the access to the forest presently afforded them is not enough (though some admit to not using it at all). Behind the complaints, however, there appears to be an understanding of both their misuse of the Forest Reserve and the valuable purpose served by the fence.

Opinions offered by the 'non-evictee' residents of Gakanga regarding the eviction of encroachers covered a wide range. While some expressed appreciation of the protection of the forest and for the evidence of "law and order", others commented on the apparent inconsistency of government policy and the harshness with which evictees were treated.

The majority of people said that the fence had greatly reduced the level of human-wildlife conflict, allowing them to plant closer to the Forest Reserve, and improving their chances for successful cultivation. Many recognized the compromise between providing protection to crops and no longer having unlimited access to the Forest Reserve. Many had previously used the forest extensively and without restriction for the illegal

taking of fuelwood and charcoal, and for grazing livestock. Some farmers with 1 ha of cultivated land owned 10-15 cattle. These farmers obviously depended largely on the Forest Reserve for grazing their cattle (even though illegal as grazing within Kenya's Forest Reserves was banned in 1990). Understandably, restriction of use of the Forest Reserve accounts for many of the less enthusiastic responses. Some people complained that the level of access to the Forest Reserve was inadequate, while a few commented that they would prefer being allowed to graze cattle rather than to manually collect and remove grass.

There was a noticeable lack of trust of officials by many of the people interviewed. It can be inferred that those who were extensively involved in illegal use of Forest Reserve resources are now in conflict with KWS and Forest Department officials.

In short, people living along the southern half of the Phase 2 fence were overall pleased with the fence. The exceptions were the evicted encroachers. People living along the northern half of the Phase 2 fence were generally unhappy with the fence as their considerable illegal use of the Forest Reserve had been substantially curbed, their gates had yet to open, and elephants returning to the Aberdares were having problems finding their way around the fence, causing some crop damage. KWS rangers at Rhino Gate said that the main problem these people had with the fence was that their extensive illegal exploitation of the Forest Reserve for lumber, poles and charcoal was being curtailed.

14.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. Flat to very hilly, with three large, steep valleys where the Ewaso Ng'iro East, Ewaso Ng'iro South Rivers, and Engare Ongobit Rivers flow (Maps 5 & 6). The Phase 2 fence protects the watershed and headwaters of the important Ewaso Ng'iro River which is formed by the joining of the above three rivers. This river is vital to the people of northwestern Kenya. During years of heavy rainfall, the waters of the Ewaso Ng'iro reach the Indian Ocean via the Juba River in Sudan. The Phase 2 fence, and therefore, the edge of the Forest Reserve ranges from 8,100 ft at Rhino Gate to 9,000 ft at Gakanga Gate. Soil fertility is moderately high.

Rainfall. This is one of the drier regions of the Aberdares ecosystem with a mean annual rainfall of ca. 1,100 mm (Map 7).

14.4. BIOLOGICAL ENVIRONMENT

Natural Vegetation. The southern two-thirds or so of Phase 2 is

"Bamboo" and the northern one-third is "Juniperus/Podocarpus/Olea Forest" (FAO, 1994). Both of these vegetation types lie within the "Montane Rain-forest Zone" (Hedberg, 1951). In the Gakanga area, where the Phase 2 fence reaches its highest elevation (9,000 ft), there is much large bamboo mixed with montane forest trees. However, along the northern one-third or so of this phase of the fence, the vegetation is a mosaic of grassland, dry montane forest (at about 8,100 ft), and juniper forest (starting at 8,500 ft).

Only seven species of trees were found along 10 tree belt-transects (Table 10). The four most common species of trees here are Nuxia congesta (42% of stems), Juniperus procera (29%), Podocarpus latifolius (14%), and Olea europaea (12%) (Table 12). Together these four species of tree comprised 97% of the stems. With only seven species of trees found along the 10 transects, a mean of but 2.3 species of tree per transect, and only 17.8 stems per transect, tree species richness and tree density were much lower here than for any other phase.

The landscape of the Forest Reserve along much of the fence is very attractive, particularly in the vicinity of Rhino Gate where there are large areas of grassland with juniper and podocarpus forests in the valleys and on the hillsides. In some places there are impressive trees in the forest 1 km or more back from the fence. For example, in the Gakanga area, Nuxia congesta (which is usually a small tree) reaches a circumference of greater than 2 m, and Juniperus procera reaches a circumference greater than 5 m.

Plantations and Excisions. There is one ca. 0.5 km² plantation of exotic trees at Gakanga in the former encroached area. This plantation now lies within the fence. Adjacent to this plantation and to the east lies a 3.44 km² excision from the Forest Reserve. The excised area is known as the Endarasha Settlement. One result of this excision is that part of the Ewaso Ng'iro watershed has now been badly damaged. Another result is that about a 3 km stretch of Forest Reserve buffer zone has been removed from the edge of the National Park and there are now farm plots right up against the Park boundary. There is a second small plantation of exotic trees at Gate 91 near Sabugu along the fence just south of where the Engare Ongobit River exits the Forest Reserve. This plantation is also inside the fence.

Birds. Forty-two species of birds were recorded during 16 bird censuses in the Phase 2 area (Table 19). Mean number of bird species per census was 9.7, which was the highest recorded for any of the eight fence phases. Except for Jackson's francolin, no species of particular conservation concern were found in the vicinity of the Phase 2 fence.

Large Mammals. Elephant, zebra, eland, bushbuck, waterbuck, buffalo, warthog, lion, and leopard are among the large mammals present in this area (Appendix IV). The primates here are olive baboon, Sykes' monkey, guereza, and Garnett's galago. There were no reports of bongo. Mountain reedbuck are said to be present at higher elevations. Black rhinoceros were once present in the vicinity of Rhino Gate, but no longer.

There appears to be a major route for elephants out of the Aberdares about 5 km south-east from Rhino Gate in the Karameno area near Kamiruri Farm. Here elephants leave the Forest Reserve to obtain salts at two sites; one on the Mugachi River about 2 km north of the boundary and the other about 2 km north of the boundary on the Engare Ongobit River. This may also be a traditional migratory route for elephants from the Aberdares into Laikipia District and perhaps on to Mt. Kenya. Major Carnegie at one time placed salt for elephants at Carnegie's Airfield near Suguroi Ngobit. This site is about 8 km north of Rhino Gate.

There is a site located about 100 m to the north of where the Mogachi River exits the Forest Reserve where elephants frequently pass, or try to pass. We were told by KWS rangers that the fence here has been repaired about 36 times in the past 3 years, whereas there have been few breaks elsewhere along the Phase 2 fence.

14.5 THE FENCE

Placement. The Phase 2 fence was originally constructed part way around the Karameno Triangle and would have excluded the 3 km² encroached area at Gakanga. Fortunately, this plan was abandoned, the fence was relocated along the border of the Forest Reserve, and the encroached area included within the fence (Map 10).

The Phase 2 fence begins at Wanderis Gate. The fence then follows the border of the Aberdares National Park for the first ca. 3 km north of Wanderis Gate and the Aberdares Forest Reserve border up to the Rhino Gate road.

Along the Forest Reserve the fence was placed 10 m inside the border in order to leave room for a service road along the fence and a narrow buffer zone between the fence and the farm plots. At the Watuka vehicle gate, the eucalyptus fence posts used to construct the fence south of this point were abandoned for metal posts. Metal posts were used to complete the Phase 2 fence.

The placement of the fence appears excellent and was achieved with but a small loss of forest edge habitat. Most importantly, the fence included the encroached area at Gakanga and aided in

the eviction of these encroachers. This 3 km² area can now be used to help meet the forest produce demands of the local people.

Infrastructure and Gates. Roads enter the Phase 2 area and into the National Park at Wanderis Gate at the south end and Rhino Gate at the north end. There are roads into the Forest Reserve at Gakanga, Monoro, Watuka, Embaringo, Belle View, Magunda, Gate 91, and Rhino Gate. Vehicle Gate 91 is for official use only as it was placed here primarily for movement to the small exotic tree plantation. Watuka Gate is also for official use only as it leads to the Watuka Water Project Intake which lies 3.7 km west inside the Forest Reserve. The Belle View Gate is also for official use only. Gate 91, Watuka Gate and Belle View Gate appear to be little used. There was no evidence that they were being used by trucks removing forest produce. The pedestrian and vehicle/pedestrian gates are well placed and adequate in number.

Along the Phase 2 fence, there is a pedestrian gate at Kamenda, and vehicle/pedestrian gates at Gakanga, Monoro, Embaringo, Magunda, and Rhino Gates. Thus, there are six gates (ca. one per 6.3 km) by which local people can enter the Forest Reserve and remove forest products. This means that few people living near the fence are farther than 3 km from a gate. Since the gates are near places of highest populations density, such as small villages (e.g., Gakanga), the majority of people are likely less than 1 km from a gate.

Positive Impacts.

- Forest Department and KWS have regained control of a 38 km section of the boundary of the Aberdares ecosystem, including the head-waters of the important Ewaso Ng'iro River. The products in the Forest Reserve here can now be sustainably used.
- A sense of law-and-order as concerns the exploitation of forest resources has returned to the region.
- The Aberdares Rhino Sanctuary has been extended to Rhino Gate and now includes part of the Forest Reserve.
- The level of damage by wildlife of crops, livestock and farm infrastructure has been considerably reduced.
- Grazing by domestic livestock has now been eliminated (or nearly so) within the Forest Reserve. Livestock grazing is broadly incompatible with regeneration of the natural forest, with optimal production of the natural forest, and with the conservation of natural biodiversity. Livestock grazing within Kenya's Forest Reserves was banned in 1990. Yet, the

people along the Phase 2 fence (and elsewhere in the Aberdares) have continued to graze their livestock in this Forest Reserve, causing extensive damage to the vegetation and competing with wildlife for food. Transmission of exotic, virulent diseases from livestock to already endangered populations of wildlife (e.g., bongo, eland, giant forest hog) is a serious potential risk, and one which the fence will now help to minimize.

Negative Impacts.

- Some people, particularly the former encroachers at Gakanga, are now landless and among the poorest people in the vicinity of the Aberdares. As concerns the encroachers, the following should be recognized: (1) the choice to encroach was theirs, (2) they were illegally farming in the Forest Reserve and obliterating a valuable public resource, (3) they benefited from their activities at the expense of other Kenyan's, and (4) they should have been evicted with or without the assistance of the fence. Nonetheless, the fence will be seen by some as the "cause" both of their eviction and of their present economic state.
- The movements of elephants and other large wild mammals is further restricted by the fence, and at least two traditional mineral (salt) licks are now no longer available to them. It should be pointed-out, however, that any movement of elephants here beyond the border of the Forest Reserve puts them into immediate conflict with farmers. Elephants attempting to gain access to the Forest Reserve from the east will not be able to enter unless they break through the fence or the fence is opened specifically for them. Presumably this will become less of a problem as time passes and people continue to settle in the area. Given current trends, these additional people will destroy what little habitat for elephants still exists outside of the Conservation Area and thereby the region increasingly less attractive to elephants.
- Although a good cover of grass has developed in most places where the fence has been in place for a few years, there is some soil erosion along the newly constructed fence and on the steepest and longest slopes (e.g., where the fence crosses the valley of the Engare Ongobit River just south of Rhino Gate).

Mitigation Measures and Recommendations.

- A priority of the Forest Department, KWS and ANRDP in the Phase 2 area should be to ensure that there is good control over, and management of, those forests that lie outside of the fence to the east. Of particular importance is the large South Laikipia (Tanyai/Karemeno) Forest Reserve (22 km²) which is located only about 3.2 km from the Phase 2 fence. This

Forest Reserve, if well-managed and sustainably used, has the potential to meet the requirements for natural forest products for a very large number of people. Elsewhere there are good amounts of juniper forest and exotic tree plantations scattered on private lands outside of the Forest Reserve. For example, there remains some natural forest along the Engare Ongobit River below Rhino Gate, in the Belle View area along the Kamariki River, and particularly on Ngamilil and Muti Umwe Hills between Belle View and the Watuka Settlement. The natural forest on Ngamilil Hill appears to cover at least 2 km². The owners should be encouraged to promote the survival and good management of these forest as they are important for meeting the demands of the local people for forest products.

- As there are farms on the perimeter of the Phase 2 fence, and since the main function of the fence is to reduce human-wildlife conflict, it is not possible to allow elephants to pass from the Forest Reserve and onto farmland to reach the two mineral licks and/or to move deep into Laikipia District via this route. As the primary objective of those elephants leaving the Forest Reserve along the northern end of Phase 2 is probably to obtain salts, the area in the Forest Reserve to the south of Rhino Gate would be an ideal place to establish two artificial mineral licks. All mineral licks should be at least 2 km from the fence and placed near elephant paths. In this region, one mineral lick might be placed in the vicinity of the Engare Ongobit River and the other in the Karemeno area at the head-waters of the Mugachi. Information on how to establish artificial mineral licks is provided in Clark (1965).
- KWS and Forest Department should investigate the feasibility of strengthening the fence over those short stretches where there is frequent damage or breakage by elephants. Additional strands of electric wire on both sides of the fence along these stretches might greatly reduce damage and be worth the additional expense.
- Although people living in the vicinity of the Phase 2 fence appear to be among the most prosperous of those living around the Aberdares, there are some very poor people living in the Gakanga area who were former encroachers. The Gakanga area has some tourism potential as the fence here is at a high elevation (9,000 ft) on the lower edge of the bamboo zone, and there is access to the National Park from this area. It might be an excellent place to, for example, establish a facility for horseback riding within the Aberdares Forest Reserve and National Park. Riders could move along a series of interesting roads and horseback trails that take them through montane forest, bamboo and up into the moorland and alpine zones. Focusing development activity of this kind on the Gakanga area would help to reduce the level of poverty and

further reduce pressure on the Forest Reserve, particular if this was developed as a "community driven tourism initiative".

- The Rhino Gate area has considerable potential for tourism development with an extremely attractive landscape, access to the highest vegetation zones of the Aberdares, and trout fishing in the Engare Ongobit River. Tourism facilities might be developed here under the ANRDP.
- ANRDP should focus on the Gakanga area for out-of-forest development, particularly the establishment of woodlots, soil conservation and environmental education.
- Some pedestrian gates need to be better manned. Although the fence has greatly reduced the illegal taking of forest products, and our observations indicate that most gates are diligently manned, this was not always the case. Forest Department, KWS and the local authorities need to ensure that all gates are continuously and effectively manned when open for public access.
- The Forest Department camp at Rhino Gate, and the KWS camps at Gakanga and Embaringo were badly littered with trash, including plastic bags. All Forest Department and KWS camps, particularly those in and near the Conservation Area, should be properly maintained and kept clean.

14.6 COMMENTS

- FAO (1997) claims that the Phase 2 fence, "Increased access to forest by vehicular traffic and possibly increased illegal forest activities (some evidence of illegal logging and poaching was witnessed by the EIA mission). This could be attributed to clearing but not fencing Phase III, thereby providing easy access to large vehicles." This is a surprising and untrue statement. It is certainly based on very limited observation and information. The Phase 2 fence effectively closed off the Watuka, Ryder's Camp, Karemeno, and Belle View Roads, and numerous lesser roads that entered the Forest Reserve for the purpose of removing forest products. This leaves only three vehicle gates along the Phase 2 fence and all of these are well manned. While it is probable that some forest products are still being illegally removed from the Forest Reserve, there is no doubt that this is but a tiny fraction of what was being removed prior to the construction of the fence.
- FAO (1997) says that the Phase 2 fence restricted legal access to the forest by local communities, particularly in the northern section. During our survey we found no evidence that people who had a legal right to be in the Forest Reserve were

being denied entry. Concerning access to the forest along the northern part of the Phase 2 fence, the FAO/EIA team should have been aware that only two local people had purchased permits to take forest products through the Rhino Gate. This means that only two people had a "legal right" to gain access to the Forest Reserve.

- FAO (1997) mentions the, "Adverse visual/landscape impact of fence and fence-line." While this negative impact of the Phase 2 fence is there, this is an extremely minor consideration when measured against the "adverse visual/landscape impact" caused by clearing of the forest by encroachers and loggers.

14.7 CONCLUSIONS

The existing Phase 2 fence has already proven to be of great conservation benefit to that section of the Aberdares Conservation Area which it was constructed to help protect. Unsustainable extraction practices have all ceased to occur along the Phase 2 fence, and Forest Department now finally has control over the forest, its management, and its exploitation. The valuable area can now be utilized for the long-term benefit of all Kenyan's rather than for the short-term benefit of but a relative few.

FAO (1994) was also very positive about the Phases 1 and 2 fence, stating "The recent erection of 70 km of electrified fence, built in a cooperative spirit with local people, and incorporating a series of gates to which they will be allowed access to the forest, has produced a very positive attitude in forest/people relations: the people feel safe but not cut off from their resource bank. This augers well for the conservation of the forest and for the development of the rural economy in the buffer zone."

15. PHASE 3 FENCE

15.1 BACKGROUND TO THE FENCE

Location. North end of Aberdares, from Rhino park gate to Shamata park gate to Malewa River canyon (Map 11).

Status. Fence-line cleared in 1996-97. Fence erected for 1 km beyond Rhino park gate, but not past that point.

Length. 36 km (measured on ground).

Purpose. To extend the black rhinoceros sanctuary, reduce human-wildlife conflict, and assist Forest Department and KWS to stop the current unsustainable utilization of the forest of the Phase 3 area, allowing for controlled removal of forest products.

15.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use.

- Number of people interviewed: 36
- Population density near forest: relatively low.
- Mean size of farm plots: 3.3 ha.
- Main crops: maize, beans, potatoes, livestock.
- Conservation Area: Farm plots against border of Forest Reserve for all but ca. 12 km where they are against the border of the National Park.

Crop and Livestock Damage. The most important problem species along the Phase 3 fence-line are elephants, Sykes' monkeys, and porcupines on the east side and elephants, lions, baboons and antelopes on the west (Appendix I). People on the east side, who live close to the end of the Phase 3 fence, claimed that they experienced little crop damage but a fair amount of livestock loss to wildlife. People in the west, far from the existing fence, claimed much damage to crops and little loss of livestock to wildlife. Baboons are said to be present in this region but they are certainly uncommon and not a serious crop pest. People protect their crops and livestock by sleeping outside, maintaining fires, and making noise. They claim that wildlife causes them fear, and loss of sleep and freedom of mobility.

Past and Current Use of the Natural Forest. Local people say

they make but moderate use of the Conservation Area for fuelwood, grazing and water. The KWS rangers at Shamata claim, however, that there is overall heavy exploitation of the forest for fuelwood, lumber and posts. This survey found extensive use, most of it illegal, in the Phase 3 area of both the Forest Reserve and the National Park for fuelwood, grazing, posts and lumber.

There is widespread and intensive grazing of livestock in the natural forest along Phase 3. This illegal activity was probably at a similar intensity in the Forest Reserve along Phase 2 prior to the construction of the fence. Cattle grazing is conducted openly and in the vicinity of all Forest Department and KWS stations located in the Phase 3 area. A Forest Guard at Kirioغو said that the people here pay KShs 10 per month to graze each cow in the Forest Reserve.

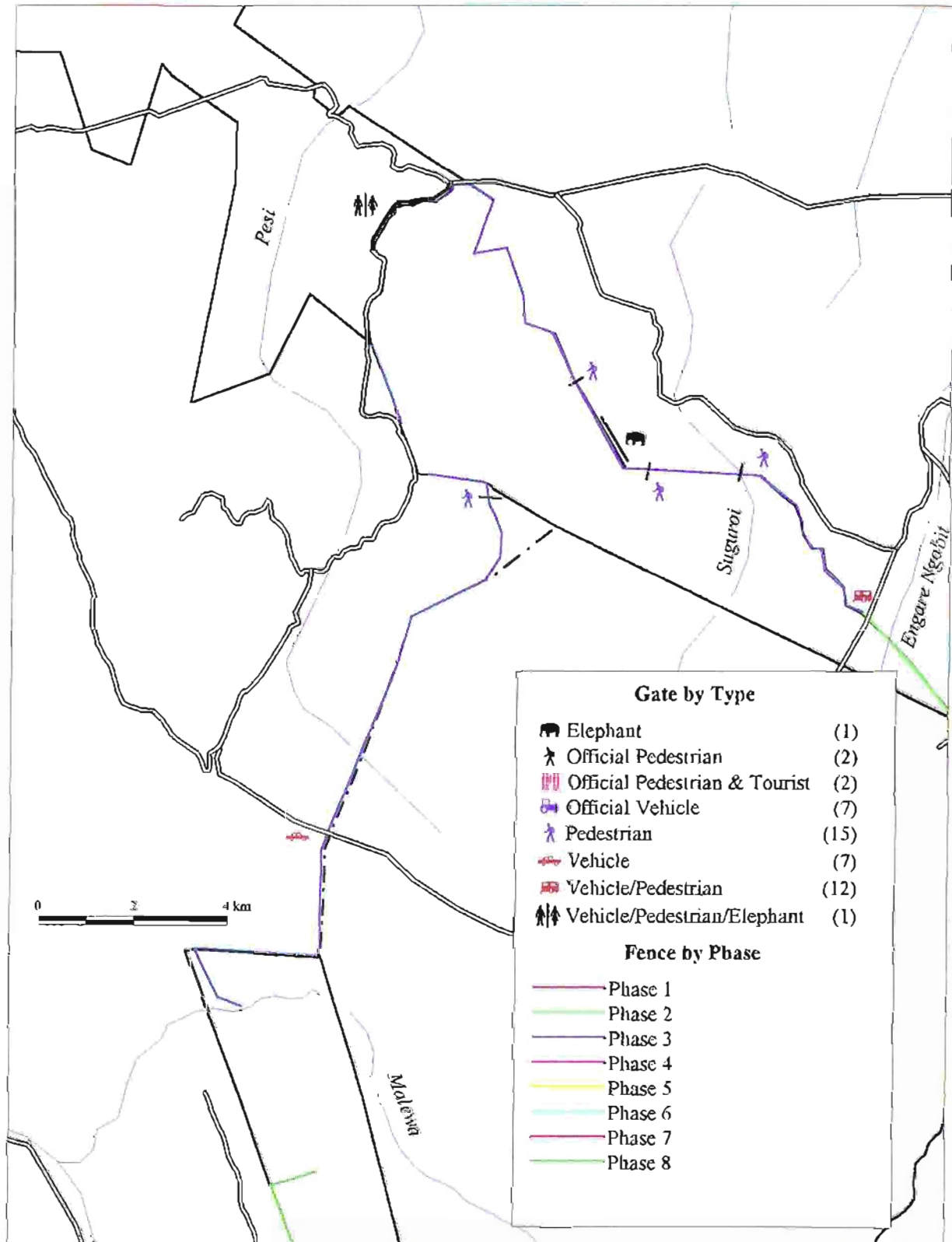
In some places, particularly in the vicinity of the United Sawmill at the north end of the Aberdares, there is much cutting of large and medium sized trees for charcoal. The wood is carried out of the forest by cart and the charcoal pits are established outside the boundary. This is a badly over-utilized, degraded area of bush and forest where grazing by cattle, goats and sheep is intensive and openly conducted.

At the northern end of the Aberdares lies that portion of the Aberdares Forest Reserve known as the Ndaragwa Forest. The part of this Forest Reserve which lies to the north and west of the Nyeri-Shamata Road has natural forest that covers an area of about 13 km², plus several plantations of exotic trees covering perhaps 3 km². This area, once covered by a forest of large juniper, is now extremely over-utilized and degraded. It appears that about one-half of this forest has been destroyed by encroachers. The Shamba System was said to be in use, but it is obviously not regulated by Forest Department. The strong impression gained was that Forest Department was not managing, controlling or protecting Ndaragwa Forest Reserve, and that a valuable area for the production of forest products was being rapidly destroyed.

Within the Phase 3 area, recent and current logging was most intensive and obvious within the National Park in an area near the border and only ca. 3 km south of the KWS Shamata Station. Here many very large Podocarpus trees had been cut over the past few years. The cutting was on-going. There was no evidence that KWS was making any effort to stop this blatant illegal damage to the Park.

Extensive illegal cutting and removal of juniper posts was observed at several locations, particularly to the east of Kambaa.

Map 11. Recommended location of the Abardares Conservation Area Phase 3 fence and gates.



Attitudes Towards the Fence. People near the Rhino park gate at the beginning of Phase 3, as are the people near this gate at the end of Phase 2, were not happy with the fence as it had not as yet been effective in stopping elephants from visiting their farm plots. At the same time, however, their unrestricted use of the Forest Reserve had come to an end. It is expected that this negative attitude towards the fence will pass once several more kilometres of fence are constructed. It should be noted that people living near Rhino park gate can buy permits which allow them access to the Forest Reserve at Rhino park gate. Few had, however, purchased their permit.

On the west side of the Aberdares, where the fence-line was cleared but where the fence had not yet been constructed, 88% of the people were happy that a fence was to be build. They expressed frustration, however, in the long delay between clearing of the fence-line and the actual construction of the fence. Some claimed that during the clearing of the fence-line, some old moats had been destroyed and that this further exposed their crops to damage by wildlife. Those whose farms border on the Forest Reserve (and even some whose farms bordered the National Park) expressed desire to continue present levels of use of the resources of the protected area. In particular, they wish to continue to graze their livestock and to remove fuelwood and water. Some admitted taking posts and lumber from the Forest Reserve without a permit.

At the time of our survey, the people along Phase 3 stated that they had received little information from either Forest Department or KWS concerning the fence. FAO (1997) reiterated this problem. This is surprising as in February, 1995, KWS organized and held a 3 day workshop in Nyahururu to discuss the Phase 3 fence. The objective of the workshop, which was attended by 33 people, was to "discuss with the communities that live within the project area the implications of the electric fence and their role in its maintenance." This workshop was attended by community representatives from Shamata and Pesi.

15.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. Much of the Phase 3 area is covered with gently rolling, but large, hills with few steep valleys (Map 5). The fence here will help protect the watersheds of the Suguori River and Pesi River, both of which flow northeast through Nyandarua District and into Laikipia District. Rivers off the west side of Phase 3 flow to Lake Ol Bolossat, one of Kenya's most important wetlands (Gichuki & Gichuki, 1998). From a topographical point of view, this is one of the least challenging phases of the fence in terms of construction. Elevation along Phase 3 varies from 8,100 ft at the Rhino park gate, to 7,200 ft where the tributaries of the

Suguroi River leave the forest near Wiyumiririe, to 9,200 ft at the Shamata park gate. Soil fertility in the Phase 3 area is moderately high.

Rainfall. This is the driest region of the Aberdares with a mean annual rainfall of about 900 mm at 7,200 ft (Wiyumiririe) and 1,300 mm at 9,200 ft (Shamata park gate) (Map 7).

15.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Most of the Phase 3 area is "Juniperus/Podocarpus/Olea Forest", although there is an area of "Bamboo" in the vicinity of Shamata where the fence-line reaches its highest point (FAO, 1994). These vegetation types are within the "Montane Rain-forest Zone" (Hedberg, 1951).

Most of the lower elevations (7,200-9,000 ft) are covered by a mosaic of grassland and Juniperus procera dominated forest, while the higher elevations (>9,000 ft) have a richer and wetter vegetation type where Olea europaea, Nuxia congesta and Podocarpus latifolius are the most common species of tree (Table 12). Overall, along the 17 tree belt-transects conducted in the Phase area, the most common species of tree were Olea europaea (29% of stems), Nuxia congesta (18%), Juniperus procera (18%), and Podocarpus latifolius (10%). Together these four species made up 75% of the stems. The almost pure stands of very large Podocarpus at Shamata are extremely impressive and an attraction in themselves. Podocarpus of this size were not observed elsewhere.

Twenty-seven species of trees were found along the 17 belt-transects. With 5.8 species of tree and 49.6 stems per transect, tree species richness and tree density were intermediate relative to the other seven phases.

Plantations and Excisions. There are six plantations of exotic trees, totalling about 3 km² in the north extreme of Phase 3 that lie within the planned fence. Three plantations lie just outside of the planned fence to the north of the Nyeri-Shamata Road. There are no known excisions of Forest Reserve in this area.

Birds. Forty-three species of bird were found along 17 transects (Table 21). Mean number of bird species per census was 7.2 (Table 19). No rare species of bird, or species of particular conservation concern were located in Phase 3. It should be noted, however, that this was the only phase in the Aberdares where the Abyssinian ground thrush Turdus pita, little rock thrush Monticola rufocinerea, and speckled pigeon Columba guinea were found (Table 22).

Large Mammals. Elephants, black rhinoceros, zebra, buffalo, warthog, spotted hyaena, lion and leopard are among the large mammals present here (Appendix IV). Sykes' monkey and guereza were also recorded. Olive baboon, bongo and eland are reported to occur. The number of black rhinoceros here is said to be 4-6 animals. The Shamata area is the only place outside of the Salient where the black rhinoceros is known to be present in the Aberdares.

There are major migration routes for elephants both off the northeast side of the Aberdares around Wiyumirire in the watershed to the Suguroi River, and off the north end of the Aberdares into the Ndaragwa Forest Reserve to the Pesi River. Elephants can move along both rivers to the large commercial cattle and wildlife ranches of Laikipia District (e.g., Ol Pejeta, Ol Jogi, Mpala, Segara, Lewa Downs). To do this, however, they must first move through areas of small scale crop farming. These migration routes do not, however, pass through areas with as high a human population density as the one south of Rhino park gate or the one off the east end of the Salient. The routes off the north end of the Aberdares also lead to areas where there are fewer people and where some sanctuary can be found (i.e., large commercial cattle and game ranches). Some elephants from the Aberdares probably eventually reach Samburu Game Reserve, Mt. Kenya and Meru National Park via routes out of the north and northeast Aberdares.

15.5 THE FENCE

Placement. The cleared line for the Phase 3 fence follows the boundary of the Forest Reserve from Rhino park gate up to the Nyeri-Shamata Road near Ildarakwa Hill (Map 11). The fence-line does not cross this road but rather follows the road southwest towards Shamata to where the Forest Reserve boundary again crosses the Nyeri-Shamata Road. From here the fence-line again follows the boundary of the Forest Reserve southeast to the boundary of the National Park near Muhiriga. The fence-line then follows the National Park boundary until this again hits the Forest Reserve boundary near the Virgins Lane Road. From here the fence-line goes near due west about 3 km to the cliffs of the escarpment and then southeast about 1 km to the very edge (drop-off) to the Malewa River Canyon. This is where Phase 3 ends.

When all is considered, this placement of the Phase 3 fence makes good sense in terms of fence construction and maintenance costs, as well as in terms of biodiversity conservation and watershed protection. All of the Aberdare's Conservation Area in the north part of the Aberdares will lie within the fence up to the Nyeri-Shamata Road. It is highly unfortunate that the 13 km² or so of natural forest in the Ndaragwa Forest cannot be

included within the fenced area, but this would mean constructing and manning two vehicle gates across the region's main road.

East of Pesi Settlement and just west of Gathariga Hill there is a triangle of good juniper/podocarpus/olive forest with Forest Reserve to the northeast, National Park to the southeast, and fence-line to the west (Map 11). Here the fence-line follows (as far as can be determined) neither the boundary of the Forest Reserve nor that of the National Park. Forest Department and KWS should be very clear that placement of the fence here will not create difficulties in the future. Putting the fence here ca. 1.5 km to the west of Gathariga Hill is important for the conservation of the area as it prevents a narrow (ca. 1.5 km wide) corridor in the Aberdares Conservation Area from being created. The placement of the fence ca. 1.5 km to the west of Gathariga Hill helps to ensure that a ca. 3 km wide corridor will continue to be maintained.

Infrastructure and Gates. The fence-line is well served by Forest Department or KWS roads along much of its length. For about 5 km it runs along side the Nyeri-Shamata Road. Elsewhere there are roads passing through farm plots up to the boundaries of the Forest Reserve and National Park.

A total of four pedestrian gates, one vehicle/pedestrian gate, one vehicle only gate, and one elephant only gate are recommended for the Phase 3 fence. Thus, local communities will have access to the Forest Reserve through five gates.

The following gates are proposed for the Phase 3 fence:

- Kiriogo pedestrian gate. As mentioned above, this is the driest region of the Aberdares and people here are highly dependent upon the watershed of the Aberdares for water. At Kiriogo there is a watering point in the forest where a large number of people go to get their daily water. The Forest Guard here claims that 1,000 people plus livestock get their water here each day during the drier months. The fence should enter the Forest Reserve here, go around the Forest Guard Station and watering point, and then return to the Forest Reserve boundary. That is, the Forest Guard Station and the watering point should be excluded from the fenced in area. There should not be an access to the Forest Reserve at this point except for water. People here can gain access to forest products via the Rhino Gate or via the Wiyumiririe gate.
- Wiyumiririe pedestrian gate. The only KWS Ranger Station between Rhino Gate and Shamata is located at a strategic location at Wiyumiririe. This station is located about 2 km west of the Kiriogo Forest Guard Station. A pedestrian gate should be placed just west of the Ranger Station. No vehicle

access to this portion of the Forest Reserve should be allowed as the area of Forest Reserve here is not large and the boundary of the National Park is located only ca. 1.7 km to the southwest. This is an area which has been extensively grazed by livestock (illegally) and where the taking of forest products has been both unsustainable and apparently largely without permit. This is also another watering point for the local community. Enforcing the Forest Department's ban on grazing here should allow for regeneration of this natural forest and provide for the greater protection of this watershed upon which the local community and people in Nyandarua and Laikipia Districts depend. The people of the Kiriogo and Wiyumirire areas frequently move through the Forest Reserve west to the Pesi Settlement area to sell their products, shop and visit the medical clinic. Their continued use of the route through the forest between Wiyumirire to Pesi should be permitted as long as this "privilege" is not abused by damage to the forest or the illegal taking of forest products.

- Wiyumirire elephant gate. The Wiyumirire-Kiriogo area lies on a traditional elephant migration route. A gate should be constructed in the fence here that can be opened to allow elephants access to the Forest Reserve. This gate should be about 5 m wide, locked, and opened only when elephants are in the vicinity and on the outside of the fence. The gate should be placed on the most used elephant route between the Forest Reserve and the surrounding land. The exact location of this gate should be determined by KWS and Forest Department personnel in consultation with the local communities as it is the local people who have the most knowledge of elephant movements in this area. This is not a vehicle or pedestrian gate.
- Deighton Downs pedestrian gate. There is an exotic tree plantation of ca. 1 km² located about half way between the Wiyumirire Ranger Station and where the Nyeri-Shamata Road enters the Forest Reserve. There is a Forest Guard Station at this plantation. A pedestrian gate needs to be placed here. The plantation here has not been well managed but it and the surrounding Forest Reserve can help to meet the needs of the local community for forest products. The area is badly over-utilized but should recover with time once the rate of exploitation is brought under control.
- United Sawmill vehicle/pedestrian and elephant corridor (no fence or gate). This is the only elephant "open gate" recommended for the Aberdares Conservation Area. The gate is located on the Nyeri-Shamata Road and begins just east of where the road to the United Sawmill enters the Forest Reserve. There should be no fence from this point for a distance of ca. 1.5 km to where the 2,400 m contour line

crosses the road. A corridor here will allow elephants to leave the Aberdares Conservation Area to disperse into the Ndaragwa Forest and move north and east into Laikipia District. The presence of the Ndaragwa Forest here, which is mostly natural forest (ca. 13 km²) with a small area of exotic tree plantation (ca. 3 km²), means that the elephants will have the opportunity to disperse before moving into and through the surrounding farmlands. In other words, the Ndaragwa Forest will serve as a "soft edge" or "buffer zone" for elephant dispersal. At all other places along the boundary of the Aberdares Conservation Area there are either farms right up against the boundary or exotic tree plantations. At the north end of the Aberdares Forest Reserve is found the only place around the Aberdares Conservation Area where there is a combination of (1) extensive natural forest beyond the wildlife fence, (2) a known elephant migration route, (3) a relatively low human population density, and (4) a place into which elephants can move and find sanctuary (*i. e.*, the commercial ranches of Laikipia District). Also, human access along this non-fenced stretch to the area southeast of the road should not be too difficult to control as the terrain is fairly steep and the only road here into the Forest Reserve from the Nyeri-Shamata Road is at the United Sawmill. Another point in favour of locating an elephant corridor here is that this is where the Nyeri-Shamata Road passes through the Forest Reserve and, as such, there are no people living within ca. 1 km of either end of where the fence stops to create his corridor. This is also an entrance point to the Forest Reserve both for vehicles and pedestrians. The United Sawmill is no longer in operation, but Forest Department will need vehicle access to the plantations within the fenced area, including the plantation at the Deighton Downs pedestrian gate (which can be reached by the current road system from the saw mill). The forest here is some of the most degraded within the Aberdare Conservation Area and the removal of forest products will need to be greatly reduced if the forest here is to recover. Still, some limited taking of forest products should be allowed in order to help the local people meet their needs.

- Pesi pedestrian gate: A pedestrian gate needs to be placed at the site where people enter the forest from Pesi Settlement to move through the Forest Reserve along the footpath to the Wiyumiririe-Kiriogo area. Exactly where this footpath enters the Forest Reserve at Pesi was not determined. Therefore, the site shown on the map may not be accurate. The exact location of this gate should be determined by KWS and Forest Department in collaboration with the local authorities and people. In order to man this gate, KWS want to move its (now unmanned) Ranger Camp at Muhiriga to the site of this gate.

- Shamata park gate. Most of the remainder of the Phase 3 fence is along the boundary of the National Park where people are not allowed to take forest products. Therefore, no pedestrian gates are needed. The only gate required is the Shamata park vehicle gate which leads to the KWS Station and into the Park. There is a small area of Forest Reserve (ca. 4 km²) at the end of the Phase 3 fence but this area is largely grassland with no trees. Since fodder for livestock is the only product here, and since grazing in Forest Reserves is no longer allowed, there should not be a gate here.

Positive Impacts.

- Forest Department and KWS will regain control of a 36 km section of the boundary of the Aberdares ecosystem and the land there in, including the highest portions of the watersheds of the important Pesi and Suguroi Rivers. The over-exploited, seriously degraded forest here will be able to recover, making long-term, sustainable utilization of vital forest resources possible.
- The Aberdares Rhino Sanctuary will be extended to the Shamata sector of the National Park. With this added protection, populations of black rhinoceros, bongo, eland, zebra and other large mammals are expected to recover from their present low numbers.
- Damage by elephants and other wildlife on crops, livestock, and farm infrastructure will be greatly reduced.
- The Shamata sector of the National Park is especially scenic and biologically interesting, and the climate is excellent at 9,200 ft. Yet this area is little visited by tourists. There are several sites here where a game lodge might be built. What is now most needed before this might be done is for wildlife populations to increase in this part of the Park. The fence should allow for this to happen.

Negative Impacts.

- As noted above, the Phase 3 fence-line was cleared in 1996-97. As of early 1999 only 1 km of this 36 km long fence had been constructed. The reason for this is that funding for construction of the Phase 4 fence was made available while there is not yet funding for construction of the Phase 3 fence. KWS and Forest Department, therefore, have (since 1996) focused on constructing the Phase 4 fence. It is unfortunate that the fence-line for the Phase 3 was cleared so much in advance of the construction of this fence. This created the following problems:

- Apparently some people, seeing the fence-line cleared and anticipating the quick construction of the fence, increased their rate of illegal exploitation of forest products within the Phase 3 area, particularly of juniper and podocarpus.
- Local communities are disappointed that relief from damage to crops, livestock and infrastructure by wildlife did not quickly follow the clearing of the fence-line.
- As the fence was not in place there was no action to plant grass to reduce soil erosion. As such, soil erosion was severe in places.
- In some areas the old game moat was filled-in by the fence clearing operation. People claimed that this had actually increased their problems with wildlife.
- The fence-line is now covered with quick growing colonizing plants. Manual labour will need to be hired to remove this growth.
- Some of the most prosperous people around the Aberdares live in the Shamata and Pesi areas. Many of these people have access to forest produce outside of the Aberdares Conservation Area. Nonetheless, there are people with small land holdings who will experience hardship due to the limited access to forest products that the fence will bring. As many of these poorer people as possible should be employed in fence construction/maintenance and boundary marking jobs as possible. Special attention should be given to them by the ANRDP in helping them better manage and utilize those forest resources which remain outside of the fence.
- The geographical ranges and movements of elephants and other large wild mammals in the Aberdares ecosystem will be further restricted, although there will be a corridor at the north end of this ecosystem to allow some movement of elephants and other large mammals into and out of this Conservation Area.
- Clearing of the fence-line caused damage to the natural vegetation and soil. In some places this damage was unnecessarily extensive. For example, near Pesi the fence-line passes through an area of exceptionally large podocarpus trees. Here many large trees were cut to clear a swath ca. 19 m wide with a line of forest debris another ca. 4 m wide to either side of the cleared area. The ANRDP Identification Report (1994) specified that a 7 m wide fence-line will be cleared, while the KWS guide-lines for fencing indicate that the fence-line should be cleared 7-10 m wide.

It is probable that this wide clearing was made to prevent the large trees from falling onto and destroying the fence. It seems, however, that other action could have been taken to limit big trees from falling onto the fence, such as cutting only those tree leaning in the direction of the fence, or pruning the branches off the side of the tree facing the fence. Not only is a fence clearing of this width unsightly, and wasteful of forest products and of wildlife habitat, it adds to the problem of soil erosion. Perhaps most importantly, it sends the wrong message to the local community (e.g., "KWS and Forest Department damage the forest while we are told not to.")

Mitigation Measures and Recommendations.

- More effort needs to be made by KWS and Forest Department to involve local communities in the construction and maintenance of the fence, and in the sustainable use and conservation of the Aberdares ecosystem. To date, community participation in the Phase 3 fence project has been inadequate.
- There appears to be far more natural forest and exotic tree plantation on private land in the Shamata and Pesi areas than in any other region off the perimeter of the Aberdares Conservation Area. The farm plots here are especially large. It is estimated that 20% of the land outside the Aberdares Conservation Area is covered with juniper forest and plantations of exotic trees, particularly on hilltops and in the Pesi River valley and its tributaries. At Muhiriga, east of Pesi and on the edge of the Forest Reserve, there are also large plots of farm land and some big patches of natural forest. It would seem that the people living in this area do not have much of a problem meeting their demands for forests products. Off the east side of the Phase 3 area there are additional areas of natural forest on private land. To the north and east of the Deighton Downs Airstrip, and to the north of Kiriogo and Wiyumiriri there are fragments of natural forests on private land. While all of these natural forests are undoubtedly "creamed" of any timber trees and badly degraded, they could be managed sustainably and remain productive forests to provide forest products to local communities. A priority of the ANRDP should be to ensure that these natural forests on private land be sustainably managed, that woodlots of exotic trees be considerably increased in size and number, and that the Forest Reserves outside of the Phase 3 fence (e.g., the Ndaragwa Forest) be well protected, made productive, and sustainably utilized. The ANRDP should focus on enabling and encouraging the local people to meet as much of their forest product needs from exotic tree plantations and from natural forest outside of the Aberdares Conservation Area as possible. This activity would probably do as much as any to help maintain and expand a buffer zone

for the Aberdares Conservation Area, thereby minimizing human pressure both on the Aberdares Conservation Area and on the fence.

- The Ndaragwa Forest to the northwest of the Nyeri-Shamata Road is being rapidly destroyed. The many active farm plots in this forest reserve appear to represent agricultural encroachment as there is little evidence that plantation trees are being planted. The fine juniper forest here is being destroyed to plant crops. At the time of the visit by this survey team there were a large number of people in this forest farming and removing forest products. As mentioned above, this natural forest is critical to the conservation of the Aberdares ecosystem and needs to be protected and sustainably used. It is strongly recommended that Forest Department and KWS take immediate action to (1) investigate and assess illegal activities in Ndaragwa Forest, and (2) put a quick stop to all illegal and otherwise unsustainable activities. Once Forest Department and KWS regain control of Ndaragwa Forest, it is recommended that it be made a priority site for ANRDP conservation activities. Boundaries need to be well marked, access needs to be controlled, indigenous trees planted, and a program of sustainable utilization firmly established. These undertakings would provide jobs for a large number of those people who are currently destroying this forest.
- Forest Department and KWS need to consult with the local people concerning the locations of the pedestrian gates. In particular, the location of the pedestrian gate at Pesi needs to be determined. This gate should be convenient for those people walking to Pesi through the Forest Reserve from the Wiyumirire-Kiriogo area. The Phase 3 area is where access to water sources within Forest Reserve are most critical for the local people. Care needs to be taken to be certain that all necessary "drought period gates" to needed water sources are constructed.
- Consider placing artificial mineral licks within the National Park in order to help keep elephants away from the fence, particularly in the vicinity of Wiyumirire and Kiriogo.
- Promote ecotourism in the area between Rhino Gate and Shamata Gate, particularly wilderness hiking and camping.
- The community living around the Ndaragwa Forest will continue to be in conflict with wildlife as there will not be a fence between their farms and the wildlife of the Aberdares Conservation Area. Whether the level of human-wildlife conflict around Ndaragwa Forest will increase or decline as a result of the Phase 3 fence is impossible to say at this time. Nonetheless, the local communities near Ndaragwa Forest will

not receive the protection from wildlife damage that many other farmers around the Aberdares will enjoy. Forest Department, KWS and the ANRDP should give particularly attention to the people of this area both through consultation and awareness campaigns, employment, and probably also through support of various community development projects (e.g. , road, medical clinic and school construction or repair).

- The sole remaining elephant corridor out of the Aberdares Conservation Area runs across the Nyeri-Shamata Road, through the Ndaragwa Forest and into Laikipia (Section 13.5). The priority for elephant conservation in the region at this time should be to ensure that the "Ndaragwa Elephant Corridor" is not destroyed. This corridor is presently being negatively affected by land division, human settlement and livestock fences. The Ndaragwa Elephant Corridor will be lost within the next few years unless actions are taken soon. Protecting and maintaining this corridor should be a priority of the ANRDP.

"Corridors" are a major topic at this times among conservation biologists. Since substantial funding would likely be required to protect and maintain the Ndaragwa Corridor, and since this corridor has important conservation implications for elephant and other species, such an innovative, challenging, and high profile project might be an excellent candidate for funding under the World Bank/UN GEF.

- Research on, and monitoring of, elephants in the Phase 3 area should be undertaken. The focus should be on gathering baseline information on the absolute or relative numbers of elephants using the Forest Reserve which lies between Gathariga (Kwa Wagura) Hill and Ndaragwa Village (i.e., the Ndaragwa Elephant Corridor). The primary questions to address are: (1) What are the absolute or relative numbers elephants using this corridor? (2) How many of the elephants using this corridor gain access to areas north (outside) of the Aberdares ecosystem? (3) What kinds of damage do these elephants cause on farmlands and in plantations, and what is the level of damage? This information should be gathered before the fence is constructed, or as soon thereafter as possible. This research should be part of a long-term ecological monitoring program for the Aberdares Conservation Area. It will help evaluate the effectiveness and costs of the corridor, and serve as a gauge of changes in the level of damage caused by elephants in the Ndaragwa Forest area. This research could form the basis for at least two MSc degree projects; one in the immediate future to establish a baseline and one in about 5 years time to assess change.

15.6 COMMENTS

None.

15.7 CONCLUSIONS

The cleared line for the Phase 3 fence is well placed, running along the boundary of Aberdares Conservation Area. The only major recommendation made to the fence itself is that an elephant corridor (i.e., no fence for 1.5 km) be established in the Ndaragwa Forest at the Nyeri-Shamata Road. The main concern at this time is the long delay between the clearing of the fence-line and construction of the fence. It has now been more than 2 years since the fence-line was cleared and funding for the Phase 3 fence has yet to be secured. Once installed, the Phase 3 fence will undoubtedly do much to bring the considerable illegal taking of forest products in the area under control and allow for sustainable use.

16. PHASE 4 FENCE

16.1 BACKGROUND TO THE FENCE

Location. From the south side of the Salient at Ruhuruini park gate south along the east-central side the Aberdares to the Karuromo Road between the South Mathioya and Maragua Rivers (Map 12).

Status. Clearing of fence-line started in 1996 at Ruhuruini park gate and reached Gura River in May 1999. Fence constructed from Ruhuruini park gate to Chanya River as of May 1999. Initially, in accordance with the Project Identification Report (1994), the plan was for the Phase 4 fence to follow the boundary of the Forest Reserve. As such, some clearing of the Phase 4 fence-line was conducted along the boundary of the Forest Reserve. However, Forest Department developed a policy on fencing in and around Forest Reserves (Manegene *et al.*, 1996). This policy states that "...where plantations occur, the fence should be constructed between the indigenous forest and the plantation when feasible". Following this policy, it was decided to abandon the initial fence-line and relocate the line so as to fence out most of the plantation area, along with a considerable area of degraded montane forest.

Length. ca. 49 km (measured with Map-Info).

Purpose. To reduce the level of human-wildlife conflict in the area, to protect a large and vital watershed, and to save a valuable area of montane forest and bamboo from further destruction and degradation through over-exploitation and agricultural encroachment.

16.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use

- Number of people interviewed: 54
- Population density near forest: relatively high.
- Mean size of farm plots: 1.6 ha.
- Main crops: maize, beans, cabbage, potatoes, tea, livestock.
- Conservation Area: Farm plots up to and inside of Forest Reserve. Forest Reserve buffer zone all along boundary of National Park in the Phase 4 area.

Crop and Livestock Damage. Elephant, buffalo, baboon, waterbuck, bushbuck, Sykes' monkey, bushpig, spotted hyena are said to be the main problem species, but the importance of the various problem species varied from place to place. Overall, elephant and Sykes' monkey are probably the two species which cause the most damage in the Phase 4 area. Baboons are absent from all but the north end of the Phase 4 area.

About 60% of the people interviewed claimed they experienced much damage to crops by wildlife (Appendix I). Damage to property and livestock from wildlife was low. The level of human-wildlife conflict clearly declined from north to south along Phase 4. There are at least two reasons for this. First, there are a large number of people cultivating (illegally) deep within the Forest Reserve in the north but not in the south. Second, the Nyayo Tea Zone is present in the south and not in the north. Tea is not much damaged by wildlife and serves as a barrier between the wildlife of the forest and crops. In addition, people who grow tea spend less time growing other crops or exploiting the natural forest.

It is also important to note that almost all of the reported damage from wildlife was to illegal farm plots within the Forest Reserve and that most of these were seasonal raids by elephants. There were few reports of wildlife causing significant damage outside of the Forest Reserve.

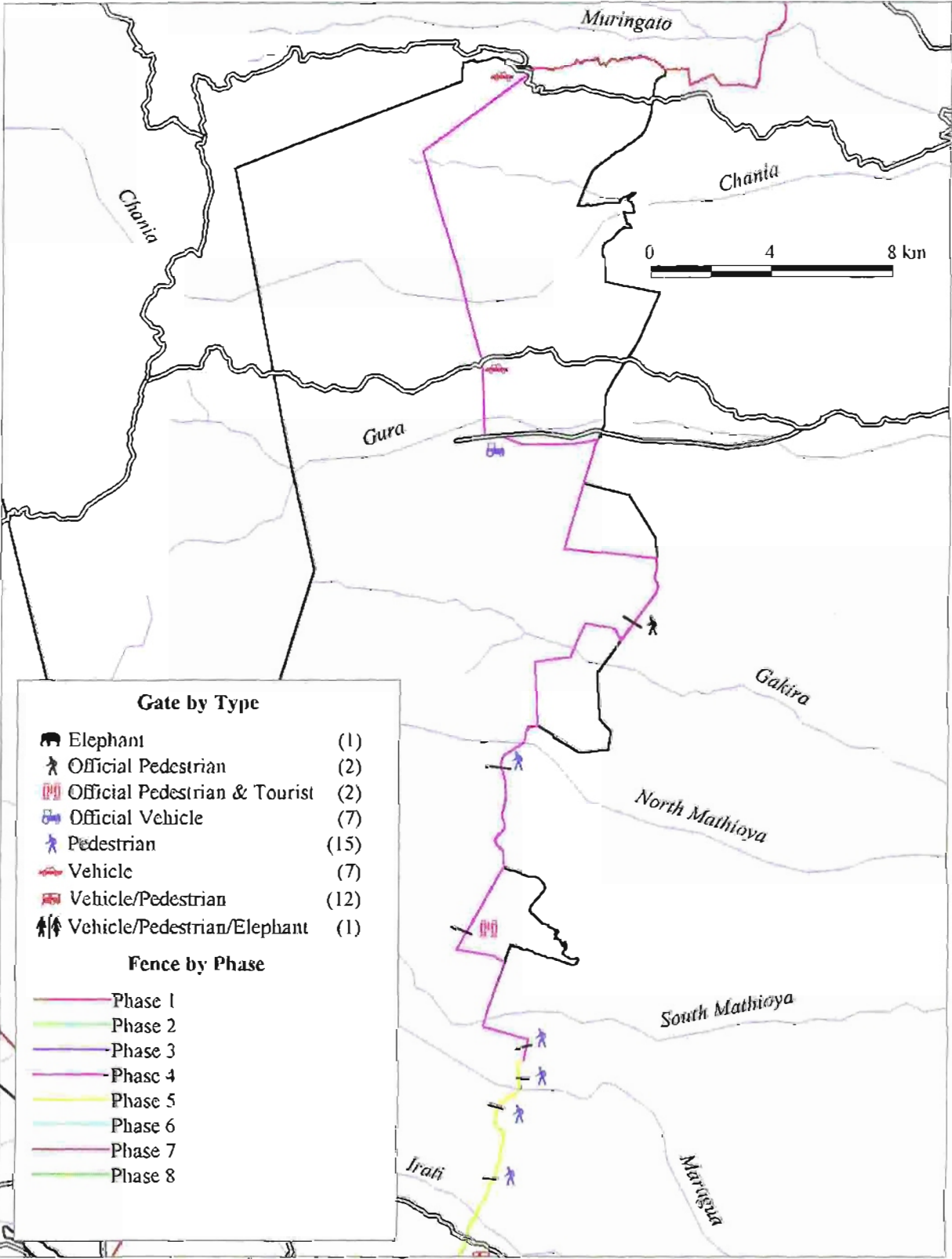
People here use fire, loud noise, dogs, spears, and stones to deter wildlife from doing damage, and conduct patrols during the pre-harvest period when their crops were most likely to be damaged by wildlife. They claim that wildlife causes them fear, loss of sleep, and freedom of mobility.

Past and Current Use of the Natural Forest. About 90% of the local people interviewed stated that they made a lot of use of the Forest Reserve for fuelwood. They also made much use of the Forest Reserve for growing crops. This is a fundamental difference between the people interviewed in the Phase 4 area and those in the Phases 1, 2 and 3 areas where none of those interviewed were cultivating crops within the Forest Reserve.

At least some people here also use the forest for grazing livestock, and for obtaining poles, honey, meat, medicinal plants, lumber and water. The grazing of livestock was extensive in many places.

The survey team observed extensive, intensive and apparently illegal exploitation of Forest Reserve resources in many places along Phase 4, particularly farming and the grazing of livestock. This was especially serious from the Ruhuruini park gate south to the Gura River Valley. In some places, semi-permanent settlements have been established within plantations

Map 12. Recommended location of the Abardares Conservation Area Phase 4 fence and gates.



(FAO, 1997) but trees were not being planted. All of these observations are assumed here to be of illegal activities. For whatever reasons, Forest Department officials were not stopping these large-scale, damaging activities to the Aberdares Forest Reserve. Many of the farm plots were established long ago, yet there was little evidence that they were being used as a means to replant plantations of exotic trees. Logging of exotic trees was also widespread, yet there was little evidence that replanting of the plantations was occurring at the needed rate. There is no doubt that the exploitation of plantation trees far exceeds the replanting or growth of replacement trees. Furthermore, much of the plantation that still has exotic trees appears to be poorly managed with unthinned and unpruned trees being common. The northern part of Phase 4, from Ruhuruini south to Kiamuturi gives the strong impression of an area no longer under the control of Forest Department. In any case, it was being extremely poorly managed either for the production of timber or for soil and biodiversity conservation.

Attitudes Towards the Fence. Fifty-seven percent of the people interviewed said that they were happy about the Phase 4 fence. Only 12% were unhappy about the fence. Their concern was that the fence would prevent them from continuing to cultivate in the Forest Reserve.

At the time of the interview, few of the people had been consulted by Forest Department or KWS concerning the fence. KWS claims, however, that considerable consultation with the local community has taken place in the Phase 4 area since this field survey was undertaken. It should also be remembered that at the time of this survey, only about 15% (ca. 9 km) of the fence-line was cleared and fence construction had not begun.

It should be noted that, unlike in the Phases 1, 2 and 3 areas, there are no nearby forest reserves outside of (to the east) the Phase 4 area. All natural forests that at one time occurred to the east has now been destroyed to make way for agriculture. This means that the Aberdares represent the sole source of natural forest products for people living over a vast region.

16.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. Moving south from the Ruhuruini park gate to the Chanya River the topography is fairly gentle (Map 5). The Chanya River Valley is very steep and deep, and the terrain to the south is, for the most part, rugged being dissected by several fast-flowing, medium-sized rivers that cut deep into the Aberdares. The major rivers flowing out of the Aberdares Conservation Area along Phase 4 are the Chanya, Gura, Gikira, Thuti, North Mathioya, and South Mathioya. All of these rivers flow to the east. Other than the west scarp of the

Aberdares (Phase 8), this is certainly the most rugged area of the Aberdares Forest Reserve and, therefore, the most challenging for construction of the fence.

The elevation of the boundary of the Forest Reserve along Phase 4 varies from ca. 6,500 ft in the north near the Salient and where the Gura River exits the Forest Reserve, to ca. 8,400 ft in the south. Soil fertility in the Phase 4 area is moderately high.

Rainfall. The Phase 4 area is the second wettest area in the Aberdares. Mean annual rainfall here varies from ca. 1,400 mm in the north at ca. 6,500 ft to 2,200 mm in the south at 8,000 ft (Map 7).

16.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Phase 4 lies in the "Montane Rain-forest Zone" (Hedberg, 1951). The "Drier Evergreen Forest" type that once covered the northeast part of the Phase 4 area has largely been removed and replaced with plantations of exotic trees. Most of the remainder of the Phase 4 area that is below ca. 7,500-7,800 ft is "Montane Rain Forest" while those parts of the Forest Reserve above ca. 7,500-7,900 ft are covered with extensive stands of medium- to large-sized bamboo.

Of the 22 species of trees found in the nine belt-transects conducted in the Phase 4 area, the five most common species were Nuxia congesta (24% of stems), Neoboutonia macrocalyx (15%), Tabernaemontana pachysiphon (11%), Podocarpus latifolius (9%), and Macaranga kilimandscharica (8%) (Table 12). These five species comprised 67% of the stems. The mean number of species per transect was 7.8. The mean number of stems/transect was 40.1 (Table 19). These transects were run in upper montane forest. The much more species rich lower montane forest that must have once occurred in this region below 6,500 ft was probably destroyed long ago.

The montane forest that does remain in the Phase 4 area is, nonetheless, of considerable importance to the conservation of biodiversity in the Aberdares. This is particularly the case for the wetter montane forest which is found over the lower elevations in the southern one-half or so of the Phase 4 area. Wet montane forest in the Aberdares is found only on the south-east and south part of the Aberdares Forest Reserve. This habitat type is not found within the Aberdares National Park. Outside the Forest Reserve, the wet montane forest has been almost completely destroyed, while within the Forest Reserve it has been extensively degraded by loggers, farmers and livestock. In the Aberdares, wet montane forest continues to be the habitat

type most under threat and, therefore, most in need of strong protection and good management.

Plantations and Excisions. Exotic tree plantations cover a considerable portion of the Phase 4 area, particularly in the northeast and along the east boundary. A visual estimate is that about 15-20% of the area is covered with plantation, or with what was once plantation. No excisions are known to have been made from the Phase 4 area.

Birds. Fifty-seven species of birds were located during 18 15-minute censuses in the Phase 4 area (Table 21). The mean number of species found per census was 9.2, which was the second highest for any of the eight Phases (Table 19). No rare species of birds were found in Phase 4, although the Aberdare cisticola Cisticola aberdare, a Kenyan endemic with a distribution limited to the highlands of central Kenya, is common in the moorlands at the highest reaches of Phase 4.

Large Mammals. Elephants are widespread in Phase 4 but seem to be in low densities in most places. Buffalo, bushbuck, waterbuck, reedbuck, black-fronted duiker, bushpig, lion, leopard, serval, Sykes' monkey, guereza, and Garnett's galago were all present (Appendix IV). Baboons were reported to be present in the north part of Phase 4 area but the survey team did not observe this species. If baboons are present they must be uncommon. Bongo likely still occur in the bamboo but this was not confirmed. There seems not to be an elephant migration route out of the Aberdares Conservation Area in the Phase 4 area. Any migration routes that might have existed here were probably abandoned long ago as there is a dense human population throughout the region to the east.

16.5 THE FENCE

Placement.

Section 4/1. Fence from Ruhuruini park gate to the Chanya River

Location: Clearing of the fence-line here was completed during the time of this survey and the fence has since been constructed. The fence runs mostly between the natural forest and the Kabage and Zaina Plantations ca. 5-6 km in from the east boundary of the Forest Reserve which lies at 6,950-7,400 ft.

Length & elevation: ca. 9 km at 7,150-8,300 ft.

What is outside of the fence and justification: Outside (east) of the fence lies an extensive area of poor exotic tree plantation, farm plots and badly degraded montane forest.

The 1975 (Nyeri) 1:50,000 map for this area shows ca. 18 km² of plantation and ca. 11 km² of natural forest in this area. Based on visual estimates made during this survey, it is estimated that this area is now 25-30% plantation (much of it poor), 10% badly degraded natural forest, and 60% active or abandoned farm plots.

Between the plantations/degraded natural forest and the fence are a large number of farm plots and people. In 1994 there were up to 300 illegal farmers near the Kabage Forest Station (Emerton & Mogaka, 1994). The impression in 1997 was that this number had increased considerably and that the encroachment was widespread. In 1997, to the inside of the fence-line from Ruhuruini park gate for ca. 5 km south, the fence-line goes through farm plots on which no trees have been planted and which extend for 50-1,000 m to the west (inside) of fence-line. While there are no permanent buildings here, it is obvious that these people have been cultivating this land for many years and that they have made no effort to replant plantations. The plantations that were in this area were harvested several years ago and not replanted. These people are encroachers who are both illegally in the Forest Reserve and destroying what remains of the plantations and natural forest, and seriously damaging the watershed. Moving south past the Zaina Forest Station, there is less encroachment and more land under productive plantation. The natural forest/bamboo outside the fence is often on the steeper ground and in the river valleys. To include more of this natural forest within the fence would have met either including more of the plantation in the fenced area or making the fence longer. Neither of these options would have improved the placement of this section of fence. The placement of the fence as it now stands is entirely satisfactory.

What is inside of the fence and justification: Most of the fence lies on the interface of an expansive area of bamboo and montane forest. Thus, the density of trees inside the fence is very low except in the river valleys. It is too bad that more natural forest in this area could not have been included within the fence. The distance from the fence to the boundary of the National Park to the west is ca. 6 km. This area is covered with bamboo. The ca. 2 km² of plantation inside the fence should be abandoned and efforts put into evicting the encroachers and into better management of the plantation and natural forest outside of the fence.

Access: If properly managed, the ca. 29 km² of forest and plantation outside of the fence should easily meet the needs of the local communities for forest products (including bamboo) and water. As such, no gate is needed

here except for the Park entrance vehicle gate at Ruhuruini.

Recommendations: (1) The large number of encroachers here need to be removed so that Forest Department can once again gain control of the Forest Reserve. Otherwise, the encroachers will destroy the plantation and natural forest. (2) There is virtually no natural forest outside (to the east of) the Forest Reserve. The land here is steep and the watershed badly damaged. This land needs to be better protected and utilized. This area should receive particular attention under the ANRDP.

Section 4/2. Chanya River to Thuti Plantation

Location: The proposed fence-line runs from 7,150 ft on the Chanya River ca. 3 km SSE to the Naivasha Road (if the terrain here is too steep, then the fence line should be moved eastwards until a suitable crossing of this large valley can be located). The fence crosses the Naivasha road at an elevation of ca. 8,330 ft (2,540 m contour) at a gap between two plantations (this is ca. 2 km west along the Naivasha Road from the Tusha Welfare Centre). Then due south ca. 2 km to the Gura River, crossing the river at ca. 6,920 ft (2,110 m contour). Then due south ca. 200 m to the southern side of the Gura River Valley floor to ca. 7,150 ft (2180 m contour). Then east ca. 4 km along the floor of the Valley and against the base of the south slope up to the boundary of the Forest Reserve at ca. 6,900 ft (2,100 m contour). During this last stretch the fence will be passing parallel to the Kigumo Road and possibly through plantation. Note that at the Gura River the fence-line proposed here departs for the first time from that which was originally proposed by Forest Department and KWS. Then SSW along the boundary of the Forest Reserve for ca. 1.5 km until the boundary turns sharply ESE. Here the fence continues ca. 2.5 km SSW to the west end of the Thuti (= Zuti) plantation at ca. 7,280 ft (2,220 m contour). Then east ca. 3 km to the boundary of the Forest Reserve at ca. 6,820 (2,080 m contour) where the Thuti River exits the Forest Reserve.

Length & elevation: ca. 17 km at 6,920-8,330 ft.

What is outside of the fence and justification: Outside (east and north) of the fence lies a mosaic of large plantations (ca. 18 km², Tusha, Kiandongoro, Gura, Thuti Plantations) and montane forest mixed with bamboo (ca. 13 km²). Most of the natural forest is on the long, steep slopes of the Chanya and Gura Rivers, and in the valleys of lesser

rivers. Some of this natural forest is badly degraded but much good natural forest remains fairly intact.

The natural forest in the region of the Hugu-ini Road is particularly nice and sizeable. Nonetheless, there are farm plots within the Forest Reserve here and numerous livestock are grazed. More than 100 people were seen entering the Forest Reserve on the Hugu-ini Road during a 1.5 h period.

The Gura River Valley is a particularly important and scenic place. From the floor of the Valley there is an exceptional view up into the higher reaches of the Aberdares. The fence will cross the river at ca. 3.8 km up the valley in from the boundary of the Forest Reserve. The Valley floor and about one-third of the distance up the slopes of the Valley are under cultivation (mostly maize) and plantation for a distance of ca. 5.3 km up the Valley from the boundary. This means that cultivation goes ca. 1.5 km beyond the fence-line. The tops of the ridges are covered with bamboo and the upper slopes are covered with montane forest. The slopes on both sides of the Valley are extremely steep, but especially on the south side. As such, it may be adequate to put the fence down from each ridge to the point where the slope become steep, and then in the bottom of the Valley up the slopes to where each becomes steep. This may well be the most challenging section for fence construction anywhere along the planned fence-line for the Aberdares.

The Njigari Road lies north of Thuti between the North Mumwe and Ndurumo Rivers. For the first ca. 1.6 km in along this road from boundary of the Forest Reserve there is a mix of plantation, natural forest and pasture. This ends at ca. 1.6 km and changes to bamboo with Podocarpus and Nuxia congesta. The road is heavily used here and many Podocarpus had been removed from the area over the past year. This damage continued until the road ended (at 0 31'19", 36 49'46", 8,000 ft), nearly 5 km into the Forest Reserve from the boundary. The fence will cut through the Njigari Plantation and protect the natural forest to the west.

The Nyayo tea zone begins along the east side of the Aberdares near the Kabage Forest and is planted extensively along the edge of the Forest Reserve starting at about Hugu-Ini. In the Thuti area, ca. 75% of the land at least 100 m out from the boundary of the Forest Reserve is planted in tea. Apparently because of the tea, the local people here are economically better off and seem to have less time or need for exploiting the natural forest.

Ample plantation and natural forest for intensive management by Forest Department and use by local communities are left outside of the fence while an unduly long fence is avoided.

What is inside of the fence and justification: Inside (west) of the fence there is a large area of mixed forest and bamboo which gives way up-slope to near pure bamboo with scattered Podocarpus. Extensive areas of montane forest remain in the Chanya and Gura Rivers Areas. The distance from the fence-line to the boundary of the National Park is ca. 6.5-9.5 km. This proposed placement of the fence includes within the fenced area ca. 10 km² of natural forest which the fence placement proposed in 1996 would have excluded. Also included are ca. 2 km² of the Chinga Plantation. This sector of the plantation should be harvested and abandoned before the fence is constructed.

Access: With about 31 km² of plantation and natural forest left outside the fence, there is no need for pedestrian gates. There needs to be a vehicle gate on the Naivasha-Nyeri Road and one in the Gura Valley. The gate in the Gura Valley is not a pedestrian gate and is for official use only. Otherwise, this gate should be locked. The upper Gura Valley has high potential as a tourism site. If a tourist camp or lodge were established here, then access would be through this gate.

Recommendations: There are illegal farm plots inside the fence for nearly 2 km along the south side of the Naivasha Road. These plots must be abandoned. Outside the fence there is a high level of illegal farming and exploitation of the forest. Most serious is the encroachment into the Tusha, Hugu-ini and, especially, the Gura Valley areas. Livestock are grazed throughout the sector. These activities need to be stopped so that the production of forest products can be optimized and pressure taken off of the fenced area.

Section 4/3. Thuti Plantation to Karumuno Forest Guard Station

Location: The proposed fence-line runs from the end of Section 4/2 south ca. 1 km along the boundary of the Forest Reserve. Then SW ca. 2 km to 6,955 ft (2,120 m contour) at the north end of the Chinga Plantation. Then follows the north perimeter of the Chinga Plantation ca. 1.5 km west, then ca. 1 km SW, then ca. 1 km west, north of and parallel to the Mucharage Road but still along the north perimeter of the Plantation. Then south across the Mucharage Road at 7,800 ft (2,380 m contour). Then due south ca. 1.8 km to the boundary of the Forest Reserve. Then follow the boundary SW ca. 2 km to the Kiamuturi Forest Guard Station.

Then follow the boundary south ca. 3 km to where the boundary starts to go east. Then leave the boundary and go SW ca. 3 km to the south end of Wanjerere Plantation at ca. 7,750 ft (2,360 m contour). This is just north of the Tuthu River. Then east ca. 1.7 km to the boundary of the Forest Reserve. Then SSW along the boundary for ca. 2.2 km. Then ESE along the boundary for ca. 1.5 km to near the Karurumo Forest Guard Station where the boundary turns south.

Length & elevation: ca. 23 km at 6,630-7,880 ft.

What is outside of the fence and justification: Outside (east) of the fence lies two areas which hold a mix of plantation, natural forest and bamboo. The fenced-out part of the Chinga Area (ca. 6 km²) is comprised of ca. 2.5 km² of plantation and 3.5 km² of natural forest. The fenced-out part of the Wanjerere Area (ca. 6 km²) is comprised of ca. 1.5 km² of plantation and ca. 4.5 km of natural forest and bamboo. These two areas, if sustainably used and well managed, should more than meet the requirements of the local communities for forest products.

What is inside of the fence and justification: Inside (west) of the fence there is a large area of bamboo and, at the lower elevations (<7,500 ft), montane forest. In some areas near the boundary of the Forest Reserve (e.g., Chinga) the bamboo is fairly large. There is a mix of bamboo and Podocarpus on the ridges and slopes, and natural forest and bamboo in the valleys. The distance from the fence-line to the boundary of the National Park is ca. 12 km. This proposed placement of the fence includes within the fenced area ca. 15 km² of bamboo and natural forest that would have been excluded from the fenced area under the initial Phase 4 fence location plan of 1996.

The Phase 4 area is one of the most rugged in the Aberdares, particularly around Karurumo. As a general rule, the lower the elevation the less difficult the terrain and the easier and less expensive it is to construct and maintain a fence. Because the boundary of the Forest Reserve runs along the lowest elevations within the Aberdares Conservation Area, it follows that from the standpoints of logistics and costs, this boundary is often the most suitable place to put the fence.

Conservation of as large an area of natural vegetation as possible is important for the protection of the watershed in this high rainfall area. Also included within the fence is ca. 1 km² of the Thuti Plantation. This portion of the plantation should be harvested prior to the construction of the fence and then abandoned.

Access: With the Chinga Area (ca. 6 km²) and the Wanjerere Area (ca. 6 km²) fenced out and available for sustainable use, there should be no need for additional access to the natural forest by people living within a few kilometres of these two areas. There are, however, ca. 5.5 km of rugged terrain along the fence-line between the Chinga and Wanjerere Areas, and ca. 3 km between Wanjerere and Karurumo Forest Guard Station, and no fenced out portions of the Forest Reserve for many kilometres to the south of Karurumo. As such, two pedestrian gates for use by the local people are required. One at the Kiamuturi Forest Guard Station, and one at the Karurumo Forest Guard Station.

At Kiamuturi there are numerous abandoned farm plots along the road for ca. 2 km into the Forest Reserve. Grazing of livestock is heavy here. South of Kiamuturi the illegal use of the Forest Reserve declines. There appear to be at least three reasons for this: (1) the farm plots are larger than to the north, (2) ca. 50% of the land near the forest is covered in tea and this gives the local communities both a good cash crop and keeps them busy outside of the forest, and (3) the terrain in the Wanjerere and Karurumo areas is very rugged, making exploitation of the forest difficult and costly.

At Karurumo grazing of livestock and collection of fuelwood occur to ca. 1.5 km into the Forest Reserve. The forest is degraded within 1 km of the edge. There is much evidence of fire entering the Forest Reserve here. The Karurumo Road once went several kilometres into the Forest Reserve. This road has not been maintained and now only enters the Forest Reserve as a well-used footpath. The Karurumo area represents one of the most rugged parts of the Aberdares, with very deep valleys and large hills.

There should be two other pedestrian gates within this sector but these should be for use only by officials and tourists (e.g., hikers, fishermen); one on the Chinga Road and one on the Wanjerere Road.

The Chinga Road leads to a dam and water intake point which is located 4.8 km into the Forest Reserve and which officials will need to be reached (by foot) from time to time. This is also an area with a serious encroachment problem with illegal farm plots to either side of this road for 3.7 km into the Forest Reserve. There is also intensive cattle grazing here up to at least 5 km into the Forest Reserve.

The Wanjerere Road leads to both a potential site for a tourist lodge as well as to a hiking trail up to the

Kinangop peaks. This road is almost unused, but passable for ca. 4.3 km from the boundary of the Forest Reserve. Therefore, only one official pedestrian and tourism gate is needed here. The Wanjerere area appears to be one of the better managed parts of the Aberdares Forest Reserve as the level of illegal exploitation of forest products does not seem to be significant, particular in forest more than 1 km into the Forest Reserve. The encroachers that were in the Wanjerere area were removed in 1994. Abandoned farm plots occur up to ca. 4.8 km into the Forest Reserve. The survey team did, however, find five poachers with at least one dog ca. 7 km along the Wanjerere Road at the proposed site for a tourist lodge (0°38' 33"S, 36°47'17"E, 8,700 ft).

There should not be a gate through the fence for the Mucharage Road. There is much agricultural encroachment and cattle grazing along this road, particularly to the north. The survey team found an active 10 ha plot of tobacco 5.6 km along the road in the bamboo at 8,440 ft. This site is 5.6 km along the Mucharage Road in from the boundary of the Forest Reserve.

Recommendations: Of the three sectors designated for the Phase 4 fence, this one is probably the most important for the conservation both of the watershed and biodiversity. This is also the sector with the least damage to the Forest Reserve and with the lowest level of illegal activity. Forest Department has been effective in recent years in removing encroachers from at least a few of the sites deep within the Forest Reserve here. As indicated above, however, there remain a large number of illegal farm plots inside the Forest Reserve in this sector, particularly along the Chinga Road and Mucharage Road. In addition, these two areas support other illegal activities such as poaching, grazing, and pit-sawing of indigenous trees. These problems should be dealt with as soon as possible by Forest Department. The fence will do much to help Forest Department regain and maintain control over the exploitation which is occurring at these two places, as well as at other sites in this sector.

Positive Impacts.

- The northern part of the Phase 4 fence (Sector 4/1) is one of the most problematic, damaged and threatened areas of the Aberdares Conservation Area. This is an area where the people have been beyond the laws of the Nation for many years. The damage to the forest estate here is widespread and severe. As in most places where people encroach upon and destroy protected indigenous forests, most or all of the people in Sector 4/1 probably own adequate land holdings outside of the Forest Reserve. The extent to which this is the case needs to

be assessed. Whatever their land situation, however, these encroachers and their livestock must be removed from the Forest Reserve so that the mandate of the Forest Reserve to provide protection to the watershed and forest products for the people of Kenya can be met. The fence will do much to protect part of this area from further over-utilization, but there will be a large area of encroached Forest Reserve outside of the fence that Forest Department will need to reclaim using other approaches. The Kenya Government and ANRDP should work with Forest Department and KWS as necessary to ensure that this problem is resolved and that this area is made once again a productive part of Kenya's forest estate.

- Damage from elephant, buffalo, Sykes' monkey, bushpig and other species will be much reduced by the fence, and thus also the level of human-wildlife conflict.
- Construction and maintenance of the fence will bring a good number of new jobs to this area, particularly if combined with reafforestation and maintenance of the extensive area of exotic tree plantation that lies outside of the fence.
- This is a scenic region, one that is located where the Aberdares Conservation Area is widest from west to east, and where some of Kenya's best and most accessible trout fishing rivers (e.g., North Mathioya, South Mathioya Rivers) are located. These attributes, together with the short driving distance from Nairobi, give the Phase 4 fence area considerable potential for the development of tourism. Section 4/3 appears particularly suitable for wilderness hiking and camping, as well as trout fishing, bird watching and nature walks.
- The area inside the fence ranges from deep valleys to steep hillsides, to relatively flat ridgetops, while the vegetation varies from wet to dry montane forest, to bamboo, to moorland. Although intensive surveys of the larger mammals in this area have yet to be undertaken, this survey found elephants throughout the Phase 4 area. The range of habitats is such that bongo can be expected to also occur. Poaching is suspected to be the major cause of the apparent decline of the bongo in the Aberdares. If so, then the fence will do much to assist the recovery of the bongo population in the Aberdares as the fence is expected to nearly eliminate poaching.
- Around most of the Aberdares, there is little suitable wildlife habitat outside of the Aberdares Conservation Area. This is particularly the case around the southern two-thirds of the Aberdares. This means that the Phase 4 fence will not significantly restrict species movement or distribution. In fact, much the opposite is expected to occur. Extensive human activity within the Conservation Area restricts the movements

and distributions of wild species. Human activity is also stressful to wildlife. The presence of the fence will significantly reduce these problems.

Negative Impacts.

The usual negative impacts of placing an electric fence through montane forest (e.g., damage to natural vegetation, soil erosion) as reiterated above, will occur along the Phase 4 fence. Probably the biggest negative impact will be on the encroachers, all of whom need to move out of the Forest Reserve.

Mitigation Measures and Recommendations.

Ecotourism should be promoted in the Phase 4 area, particularly in the Gura River Valley (fishing, camping, hiking) and in the Wanjerere Area (camping, hiking to the Kinangop peaks). Ideally, both areas would have community-based tourism that maximizes the benefits to the local people.

16.6 COMMENTS

None.

16.7 CONCLUSIONS

The placement of the Phase 4 fence as suggested here should provide maximum protection to the Aberdares Conservation Area while allowing local people adequate access to forest products, particularly in the Kabage, Zaina, Chanya, Gura, Thuti, Chinga and Wanjerere Plantations where considerable areas of plantation and montane forest are available for sustainable exploitation by local people and others. Making these plantation areas available outside of the fence means, among other things, that (1) these plantations will be largely protected from damage by wildlife, particularly elephants, and that (2) a minimal number of pedestrian gates need to be built and maintained. Taking this approach to the placement of the fence for Phase 4 means, however, that those above-mentioned areas will require serious protective and management measures, particularly the eviction of encroachers, the stopping of illegal grazing and taking of forest products, and the establishment of permanent, well-marked, boundaries. The ANRDP has a major role to play here in promoting and supporting these protective measures for all such areas not included within the fence.

17. PHASE 5 FENCE

17.1 BACKGROUND TO THE FENCE

Note: The Phase 5 area and the Phase 6 area are broadly contiguous with each other. They are similar in almost all respects. Most of what is said below concerning Phase 6 (Section 18) also applies to the Phase 5 fence and area.

Location. From the Karurumo Forest Guard Post south along the southeast side of the Aberdares to the Thika Road south to the south end of the Kikuyu Escarpment Forest at the Mweri River (not Moedi River) (Map 13).

Status. Placement of fence not yet decided by Forest Department and KWS. No activity on the ground.

Length. ca. 46 km (measured using Map-Info).

Purpose. To reduce the level of human-wildlife conflict in the area, to protect a large and vital watershed, and to help save the most biologically diverse part of the Aberdares Conservation Area from further destruction and degradation resulting from severe over-exploitation.

17.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use

- Number of people interviewed: 24
- Population density near forest: relatively high.
- Mean size of farm plots: 1.2 ha.
- Main crops: tea, maize, beans, potatoes, livestock.
- Conservation Area: Farm plots up to and inside of Forest Reserve. Forest Reserve buffer zone all along boundary of National Park in the Phase 5 area.

Crop and Livestock Damage. Elephant, Sykes' monkey, porcupine, bushpig are the main problem species in the Phase 5 area. Buffalo are not important crop pests here as they seem to be in low densities. Baboons absent throughout.

About one-half of the people interviewed claimed they experienced much damage to crops by wildlife (Appendix I). None reported damage to property by wildlife. Loss of livestock to wildlife rarely occurred. The level of human-wildlife conflict

is obviously lower here than in the Phases 1-4 areas. Nonetheless, crop damage was significant, particularly locally. It should be noted, however, that the most extensive damage to crops by wildlife occurred on illegal farm plots within the Forest Reserve and that most of these were seasonal raids by elephants. There were few reports of wildlife causing damage outside of the Forest Reserve.

People here use loud noise, fire, dogs, and traps to chase wild animals from their croplands.

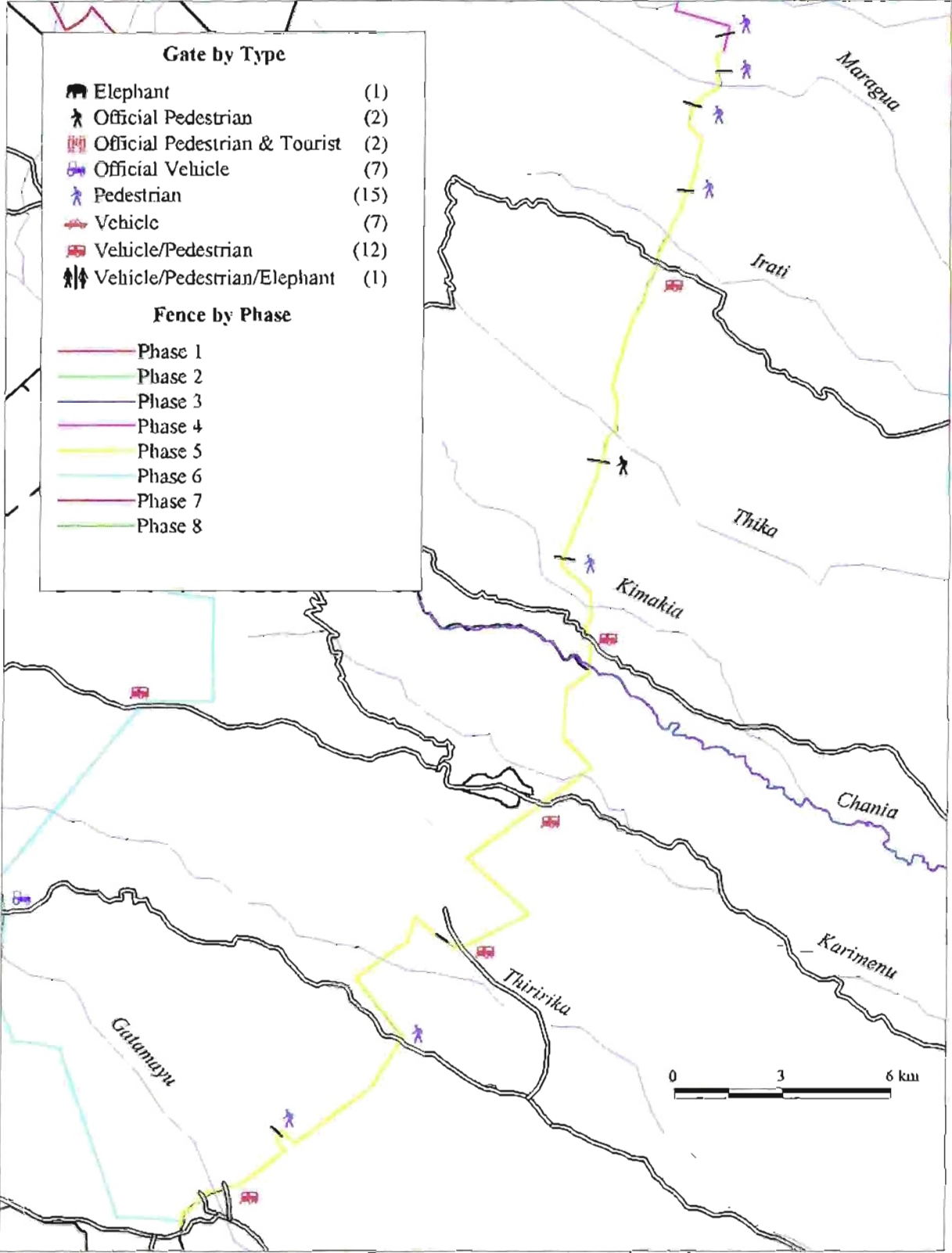
Past and Current Use of the Natural Forest. Nearly all of the local people interviewed stated that they made a lot of use the Forest Reserve for fuelwood and only a little for poles, lumber or water. They also made much use of the Forest Reserve for growing crops and grazing livestock. At least some people also use the forest for obtaining medicinal plants and water. One fundamental difference between the Phases 4 and 5 areas and the Phases 1, 2 and 3 areas is that there was no farming present in the Forest Reserve in the Phase 1, 2 and 3 areas. As in other areas around the Aberdares where people graze livestock in the Forest Reserve, the people in the Phase 5 area own considerably more livestock than their individual plots can support.

The Phase 5 area is one the wealthier locations around the perimeter of the Aberdares. This appears to be mainly due to the fact that most people harvest tea. There is ample water outside of the reserve and many, perhaps most, of the farm plots are growing exotic trees. The local people reported that their greatest problems were bad roads and the long distance to school.

The survey team observed illegal over-exploitation of Forest Reserve resources in numerous places in the Phase 5 area. The forest here was heavily logged some years ago. Illegal pit-sawing of valuable indigenous trees, such as Ocotea usambarensis, continues. Grazing livestock were often seen within the Forest Reserve and many observations were made of poles, charcoal, fuelwood and lumber being removed. Farming within the Forest Reserve was also observed. Damage to the natural forest was particularly extensive within 2 km of the edge of the boundary. Livestock were observed grazing to at least 4 km into the Forest Reserve from the boundary and indigenous timber trees were removed throughout. In many places, livestock are having a devastating impact on the regeneration of the forest.

Between the Nyanduma and Nduiriri Rivers we found particularly degraded forest. In addition to extensive livestock grazing we counted large numbers of building poles from indigenous trees along the road through the natural forest here. For example, 283 poles were counted along a 1.1 km stretch of this road.

Map 13. Recommended location of the Abardares Conservation Area Phase 5 fence and gates.



About 2 km north of this site, between the Nyanduma and Karatina Rivers, lies the ca. 0.5 km² Gachoire Pyrethrum Nursery, which is apparently not on Forest Reserve land. The crop coverage in this "pyrethrum nursery" is estimated at 50% pyrethrum, 10% maize, 10% tea, 10% pasture, 20% fallow. Around this "nursery" was found the most heavily used and degraded forest of this survey. We counted 315 poles from indigenous trees along a 5.0 km section of the road that passes through the natural forest off the NW side of the nursery.

The level of degradation of the forest in the Phase 5 area is high and will likely worsen given the obvious lack of control. We were told by Forest Department officials that people did not need permits to exploit the forest here. This was confirmed by the local people who freely admitted to not having permits to remove fuelwood, cut poles or graze livestock. People in the Nduiriri claimed that no one has needed permits to remove forest products from the Forest Reserve for 10 years. Officers of the Forest Department complained that the taking of products from the natural forest in the Phase 5 and Phase 6 areas was no longer something which they could control.

The large Gatare and Kimakia exotic tree plantations lie in the Phase 5 area, as do a few much smaller plantations. The mature trees in these plantations have been largely harvested and their removal is on-going. It is obvious that far more trees have been harvested than have been planted in the past decade. There is considerable damage here to the exotic trees by elephants. Fire is another serious problem, destroying more than 10% of the Gatare Plantation in 1997. Most roads through these plantations are in poor condition and many are no longer passable.

As with the Phase 4 area, there are no nearby forest reserves outside of, and to the east of the Phase 5 area. All of the natural forests that at one time occurred to the east have been destroyed. This means that the Aberdares are the only source of natural forest products anywhere in this region. There are, however, good numbers of exotic trees grown on the farm plots in the Phase 5 area.

Attitudes Towards the Fence. Seventy-nine percent of the people interviewed said that they were happy about the Phase 5 fence. The remaining 21% were neutral towards the fence. While these respondents understood that the fence would greatly limit the level of illegal exploitation of the Forest Reserve, they were positive about the potential reduction in damage by wildlife.

17.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. At the north end of Phase 5, at Karurumo, the terrain is very rugged, but becomes

far less so ca. 4 km south beyond the Gikigie River (Map 5). In fact, south of the Gikigie River the area is a mix of gentle hills intermixed with fairly flat areas, with some deep valleys through which the larger rivers flow to the ESE. The topography for the Phase 5 fence is much more suitable for the construction of an electric fence than that of Phase 4. Of the numerous rivers flowing out of the Aberdares along Phase 5, the largest are the Irati, Thika, Chania, Karimenu and Gatamayu.

The elevation of the boundary of the Forest Reserve along Phase 5 varies from ca. 8,400 at the north end (Karurumo) to about 6,550 ft where the Chania river exits the Forest Reserve at about the mid-point of Phase 5. Outside of the Salient, this is the lowest site in the Aberdares Conservation Area that will lie within the fence. Soil fertility in the Phase 5 area is moderately high.

Rainfall. The northern part of Phase 5, in the vicinity of Karurumo (ca. 8,400 ft), receives ca. 2,400 mm of rain per year. The rainfall at the Moeri River (ca. 7,300 ft), at the southern end of Phase 5, is ca. 1,600 mm/year (Map 7).

17.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Phase 5 lies in the "Montane Rain-forest Zone" (Hedberg, 1951). Phase 5, together with Phase 6, includes most of the "Wetter Evergreen Forest" found in the Aberdares. By far the largest block of wet evergreen forest below 7,200 ft (ca. 35 km²) lies in the east-central part of Phase 5. Forest at this elevation is particularly rich in species of plants and animals. Chuah-Petiot (1997) found that the bryoflora of the wet evergreen forest of the south and southeast Aberdares was more diverse than for other parts of the Aberdares.

Four tree belt-transects were run in Phase 5. A mean 8.5 species of trees, and a mean 72.5 stems were found per transect (Table 10). Tree species richness and density of stems were only surpassed by transects run just to the west in the Phase 6 area (9.5 species of trees and 81.4 stems per transect). The five most common trees found along transects in the Phase 5 area were Neoboutonia macrocalyx (25% of stems), Psychotria mahonii (21 %), Galiniera saxifraga (18%), Macaranga kilimandscharica (12%), and Tabernaemontana pachysiphon (8%). These five species accounted for 85% of the stems (Table 12).

As mentioned for Phase 4 above, wet montane forest in the Aberdares is found only on the south-east and south parts of the Aberdares Forest Reserve. This habitat type once extended a considerable distance to the south (to about Nairobi, 6,000 ft). Today, but there are only small fragments of natural forest remaining between the southeast edge of the Aberdares Forest

Reserve and Nairobi. Wet montane forest is the forest habitat most under threat in Kenya and, therefore, most in need of serious protective measures and good management.

Plantations and Excisions. The Gatare and Kimakia Plantations, covering ca. 28 km², are located in the north-central part of Phase 5. There is an excision of ca. 1.3 km² that lies just inside the Forest Reserve on the road from Thika. The natural forest here was destroyed so that a tea plantation could be established by the Kenyatta family. This excision was made in 1965 and 1993. The Gachoire Pyrethrum Nursery (ca. 0.5 km²) appears to be an excision from the Forest Reserve, although this is not certain.

Where the Matara Road enters the Forest Reserve there is a plantation (ca. 1 km²) of black-wattle Acacia mearnsii for a distance of 1.2 km into the Forest Reserve from the boundary. This plantation is not maintained and is unproductive. In addition, this area's main use appears to be the grazing of livestock. A man was found here illegally removing two boards of Ocotea usambarensis from the Forest Reserve. The forest along this road and beyond the black-wattle plantation is very degraded. This area should be fenced into the Forest Reserve, no gate provided, and allowed to recover.

Birds. Forty-five species of birds were found along the 19 censuses conducted in the Phase 5 area (Table 19). The mean number of species found per census was 8.1. Ten species of birds were found only in the Phase 5 area and/or only in the broadly adjacent and very similar forest of Phase 6.

Several species of birds endemic to the region, as well as several species with very limited distributions in the region, occur in the Aberdares (Taylor & Taylor, 1988; Fanshawe & Bennun, 1991). These birds are of particular conservation concern because of their restricted range, declining habitat, and generally low numbers. Of these species, those which in the Aberdares are probably confined (or largely confined) to the wetter evergreen forest of the southern Aberdares (Phases 5 & 6 areas) are as follows:

Red-chested owlet Glaucidium tephronotum
Barred long-tailed cuckoo Cercococcyx montanus
Bar-tailed trogon Apaloderma vittatum
Abbott's starling Cinnyricinclus femoralis
Sharpe's starling Cinnyricinclus sharpii
Brown-chested Alethe Alethe poliocephala
Green ibis Bostrychia olivacea (also know from a few other scattered sites around the Aberdares but nowhere common).

Large Mammals. Elephants and buffalo are widespread but in low densities throughout Phase 5 (Appendix IV). Bushpigs seem to be

widespread and fairly common. Sykes' monkey and guereza are common throughout the area. Garnett's galago is present. Baboons were not observed or reported to occur.

17.5 THE FENCE

Placement. It is strongly recommended that the fence follow the boundary of the Aberdares Forest Reserve (excluding the Nyayo Tea Zone) for the full length of Phase 5 (Map 13). There is no compelling reason for any part of the Forest Reserve, except the Nyayo Tea Zone and the plantation at the southern extreme, to not lie within the fence, nor for the fence to pass into the Forest Reserve at any point. At the southern extreme of Phase 5 lies the large Kagwe/Moedi River Plantation. This plantation should be outside of the fence, not inside the fence as recommended by FAO (1994). Thus, the Phase 5 fence ends where the boundary of the Forest Reserve strikes the Mweri River.

The forest in the Phase 5 area is of particular importance to the conservation both of this high rainfall watershed and of the region's biodiversity. The extreme over-exploitation of the forest here suggests that the only way that Forest Department will gain control of the area and allow for this forest to recover is through the construction of a fence.

Infrastructure and Gates. Except in the rugged Karumumo area, access to the proposed fence-line is relatively good as most of the fence-line is close to roads and on the edge of the Nyayo Tea Zone. There are also at least 35 roads that presently enter or go up to the boundary of the Phase 5 area.

There is no natural forest outside of the Phase 5 area. Since all Forest Reserve land, excluding the Nyayo Tea Zone and the Kagwe/Moeri River Plantation, will lie within the fenced area, there need to be a number of gates so that Forest Department and local people can enter the area to extract forest products. Major considerations as to the number of pedestrian gates recommended are as follows: (1) there are good numbers of private woodlots in the area and the vast majority of the people of the region already meet all their wood needs from these, and (2) the Nyayo Tea Zone lies along the Phase 5 fence and already represent considerable "access" to the products (land) and benefits (jobs) of the Forest Reserve. In addition, this report recommends that those many square kilometres of the Nyayo Tea Zone which are not now planted in tea be put into plantations by Forest Department with assistance from the ANRDP. These plantations will serve as a buffer to the natural forest, provide jobs and do much to meet the needs of the local people for forest products.

Due to the very steep terrain at the north end of Phase 5, the pedestrian gates there are put considerably closer together than the pedestrian gates on the flatter ground in the central and south parts of the Phase 5 fence.

Several of the logging roads into the Forest Reserve along Phase 5 are in poor condition and can no longer be driven. Also, since logging indigenous forest in Kenya is no longer legal, there is no need for these roads. This report recommends that no vehicle gate be provided for such roads. Forest Department may, however, want to place vehicle gates "for official use only" where some of these roads meet the fence. These gates should be locked except when an official vehicle needs to enter.

This report recommends that the following number of gates be constructed along the Phase 5 fence: seven pedestrian gates, five vehicle/pedestrian gates, and one official vehicle/pedestrian gate. The total number of gates recommended for the Phase 5 fence is 13.

The length of the Phase 5 fence is ca. 46 km. This means that there will be, on average, a gate every 4.9 km whereby local people can enter the Forest Reserve. Since a disproportionate number of people live along the roads that go to these gates, the average distance that a person living along the boundary of the Forest Reserve will need to travel to reach a pedestrian gate will likely be less than 1.5 km. There will be a vehicle gate, on average, every 10.7 km.

The proposed locations of these 13 gates are as follows:

- Maragua River pedestrian gate. Located where the road to the north of the Maragua River strikes the fence.
- Ichichi pedestrian gate. Located where the road from Ichichi meets the fence.
- Mununga pedestrian gate. Located at Mununga Forest Guard Post on the Mununga Road.
- Kinyona vehicle/pedestrian gate. Located where the Kinyona Road meets the fence. This is one of three gates providing access to the Gatare plantation.
- Mairi vehicle/pedestrian gate. Located where the Mairi Road hits the fence. This is the second of three gates providing access to the Gatare plantation.
- Pump house official pedestrian gate. Located where the road to the pump house on the Thika River meets the fence.

- Kimakia pedestrian gate. Located where the Kimakia Road meets the fence.
- Njabini vehicle/pedestrian gate. Located where the Njabini Road meets the fence. This is the main road from the east into the Kimakia Plantation and the third road providing access to the Gatara Plantation.
- Thika-Naivasha vehicle/pedestrian gate. Located where the tarmac road from Thika to Naivasha meets the fence. This is the main road through the Phases 5 and 6 areas. There is heavy vehicle traffic on this road. This road is the main route for removing forest products, both legal and illegal, from the Phases 5 and 6 areas. A properly manned gate here could do much to stop the current high level of illegal exploitation in these areas.
- Water pipeline official vehicle/pedestrian gate. Located where the service road for Sasumua Dam pipeline meets the fence. Vehicle access here should be limited to official vehicles only.
- Mundoro pedestrian gate. Located where the Mundoro-Kiganjo Road strikes the fence. This road is in poor condition and the forest has been badly over-utilized in this area. This road should be closed and pedestrian access only provided.
- Gachoire Pyrethrum Nursery pedestrian gate. Located where the road to the Gachoire Pyrethrum Nursery meets the fence at the west end of the nursery. The nursery area is not part of the Forest Reserve and, therefore, needs to be fenced out. This is an area of extreme forest degradation (see above) and strict control of the gate here needs to be maintained.
- Gatamayu Road vehicle/pedestrian gate. Located where the Gatamayu Road hits the fence.

What is outside of the fence and justification: Outside (east) of the fence lies the 100 m wide Nyayo Tea Zone and then a vast area of dense human settlement, cropland and pasture. Other than what is in the Aberdares Conservation Area, there are no natural Forest Reserves within the region until the south end of the Phase 5 fence is reached. Here, within the Kagwe/Moedi River Plantation, there remains small areas of severely degraded montane forest. South of here, across the Gatamayu-Bathi Road, are the Nyamweru Forest Reserve (ca. 7 km² of natural forest) and the South Kikuyu Escarpment Forest (ca. 11 km² of natural forest). Neither of these two Forest Reserves were visited during this survey but they can be assumed to be badly degraded with perhaps considerably less coverage of natural forest than stated above (as those estimates were taken from the 1:50,000 Limuru map of 1976). Including these two Forest Reserves within

the fence would be extremely difficult and expensive, both financially and politically, as the length of the fence would need to be increased by at least 22 km, people would be displaced, and many gates constructed and manned so that well-used roads passing through this area are not closed. As such, the Nyamweru Forest Reserve and the South Kikuyu Escarpment Forest should not be considered for inclusion within the fenced area.

This survey addressed the question of fence placement relative to the Nyayo Tea Zone. There is no question that those areas of the Nyayo Tea Zone which are now planted with productive tea must be left outside of the fence. These are now areas of intensive human activity. Placing the Nyayo Tea Zone within the fenced area would greatly compromise the ability of the fence to reduce the level of human-wildlife conflict, or to control illegal and unsustainable exploitation of the Forest Reserve.

The more difficult question is whether those parts of the Forest Reserve on which the natural forest has been removed but which have not been placed under productive tea should remain outside of the fence. In total this is a sizeable area of several square kilometres. Such areas are now either fallow, or used for grazing livestock or growing crops other than tea. The following options seem to be available for areas of the Nyayo Tea Zone which are not under productive tea:

1. They are incorporated within the fence, allowed to revert to natural forest, and be used as areas in which the local people can obtain natural forest products on a sustainable basis.
2. They are fenced out and used by Forest Department for establishing new plantations of exotic trees or valuable indigenous trees (e.g., Ocotea usambarensis).
3. They are jointly managed by Forest Department and the local communities as plantation forests from which the needs of the local people for forest products are met.
4. They continue to be used as at present.

Option 1 would be the best from the stand-point of watershed protection and biodiversity conservation. This option may not, however, be politically feasible. Options 2 and 3 would help these areas meet their initial objective of serving as a buffer zone to the natural forest, and could do much to meet the needs of the local people for forest products as well as create jobs. Option 4 is least acceptable as the land would not be used in a way which has much positive impact on the conservation of the Aberdares Conservation Area. The "non-tea" areas of the Nyayo Tea Zone should not be ignored by either Forest Department or

the ANRDP as they offer considerable potential for development as a buffer zone which could also meet the needs of the local people for forest products.

Forest Department should never allow the local communities to forget (1) why the Nyayo Tea Zone was created, nor (2) that the land on which the Nyayo Tea Zone occurs remains part of the Forest Reserve. These are two "cards" which those concerned with the conservation of the Aberdares ecosystem should not forget to play when working with the local communities along Phases 4 and 5 of the fence.

What is inside of the fence and justification: Within the fence lies some of Kenya's most diverse wet evergreen montane forest. Although heavily logged and severely degraded, this forest continues to have high conservation values, both for watershed protection and species conservation. With protection and proper management, this forest will recover with time, and its watershed and species conservation values further enhanced.

The large Gatere Plantation lies within the fence and is surrounded by montane forest. This plantation has been largely harvested or burnt, elephant damage to the exotic trees is high, there has been little replanting or maintenance of the plantation's exotic trees for some years, and the buildings and roads are either in poor condition or unusable. As with plantations generally, the biological values of the Gataresuch Plantation are low compared to the surrounding natural forest.

The Gatere Plantation and the contiguous Kimakia Plantation to the west are, for at least three reasons, poorly located in terms of conservation of the wet evergreen forest of the Aberdares ecosystem. First, ca. 28 km of species-rich natural forest were destroyed in order to establish these two plantations. Second, they lie in the centre of the vital corridor which connects the main block of the Aberdares Conservation Area to the biologically rich southern one-sixth of the Conservation Area. Thirdly, these two plantations allow for large numbers of people to enter deep within the Conservation Area to exploit forest products, often both unsustainably and illegally.

During this survey, consideration was given to the possibility of placing the fence so that it excluded all or most of the Gatere and Kimakia Plantations. This was rejected for the following two reasons:

- An additional ca. 30 km of fence, and two more gates, would need to be constructed and maintained. This would not be cost-effective given the low economic value of these two plantations.

- This fence placement would leave only one narrow wildlife corridor (ca. 4 km long and ca. 0.8-2 km wide) of severely degraded, natural forest to connect the main block of the Aberdares Conservation Area with the southern block. This corridor would run between the Kimakia Plantation and the Sasumua and South Kinangop Plantations to the west. Also, the main road between Thika and Njabini passes through the narrowest (ca. 0.8 km wide) part of this corridor. A single, narrow corridor is not acceptable for an area where biodiversity conservation is a major objective. Such a corridor would limit the migration and dispersal of species between the south and central Aberdares. In addition, this narrow corridor would be susceptible to destruction, in which case the south and north blocks of the Aberdares would become isolated from each other. This would be extremely negative for the conservation of this ecosystem.
- A further consideration is that such placement of the fence would be contrary to two of Forest Department's policy guidelines on fencing in forest reserves. One guide-line is that the "fence should be as short as possible". The other guide-line is that the fence should "avoid creating narrow strips of land between fence lines."

Consideration was also given during this survey to the possibility of placing a fence around the Gatere and Kimakia Plantations that would not be connected to the Phase 5 fence. This placement of the fence would mean that an additional ca. 30 km of fence and six more gates would be required. One benefit of this fence placement would be that a second wildlife corridor would be created. This second corridor would, however, be very long (ca. 6 km) and narrow (ca. 0.6-1.6 km). This placement was also rejected, largely for the same reasons that the single corridor option was rejected.

One of the most important and strongest recommendations of this report is that the exotic trees in the Gatere and Kimakia Plantations be harvested, and that these two plantations then be abandoned and the area allowed to revert back to natural forest. This action would (1) greatly reduce the costs of constructing and maintaining the Phase 5 fence, (2) be the best possible situation for biodiversity and watershed conservation in the southern Aberdares, and (3) allow Forest Department to focus its limited resources on making the extensive "perimeter plantations" and the unproductive parts of the Nyayo Tea Zone of the Aberdares Conservation Area more secure and more productive.

Positive Impacts.

- Damage to crops by elephant, Sykes' monkey, bushpig and other wildlife will be greatly reduced by the fence, and thus also the level of human-wildlife conflict.

- Construction and maintenance of the fence will bring a good number of new jobs to this area, particularly if combined with the establishment and maintenance of tree plantations on the extensive unproductive parts of the Nyayo Tea Zone.
- The fence will do much to help protect Kenya's most critical watershed and one of the nation's most important sites for the conservation of biodiversity. With the fence, eventual recovery of this damaged portion of the Aberdares ecosystem is expected to occur. As areas of old growth return to the wet evergreen montane forests of the southern Aberdares we can expect some species to increase in numbers and distribution. For example, hole-nesting species of birds that require large tree cavities or nest cavities high above the ground would be expected to be favoured by the large trees present in old growth forest. Certain species of hornbills, owls, parrots, bee-eaters, trogons, rollers, wood hoopoes, barbets, tits, woodpeckers, starlings and swallows would be expected to increase in number.
- Poaching will be considerably reduced by the presence of the fence. Populations of the more heavily hunted species, such as francolin, guinea fowl, duikers, bushbuck, bongo and buffalo, are expected to increase.
- Around most of the Aberdares there is virtually no habitat outside of the Aberdares Conservation Area that is suitable for wildlife. This is particularly the case for the southern two-thirds of the Aberdares. It is vital, therefore, that the fence not restrict the movements or distributions of wild species. Just the opposite is expected to occur with the placement of the Phase 5 fence that is recommended here. Extensive human activity within the Conservation Area and large areas of plantation restrict the movement and distribution of wild species, and the area of habitat available to them. The fence will significantly reduce these problems, providing wild species with greater freedom of movement and more habitat (as natural habitat replaces plantation).

Negative Impacts. The usual negative impacts of placing an electric fence through montane forest (e.g., damage to natural vegetation, soil erosion), as discussed above, will occur along the Phase 5 fence. Probably the biggest negative impact will be on the people who have been illegally removing products from the Phase 5 area. This impact is not expected to be too severe, however, as 12 access gates will allow for the continued taking of forest products. In addition, there is a considerable area outside of the Forest Reserve on which woodlots have been established on farm plots. The expansion and better management of private woodlots can be encouraged and promoted to help meet the growing demand.

Elephant damage to the plantations located within the fence will likely increase. As pointed-out above, however, these plantations have already been largely harvested, are not being replanted, and continue to be poorly managed and protected.

Forest Department does not have the capacity to properly manage all of its plantation land and is unlikely to have such capacity in the foreseeable future. If "plantation triage" is to be practiced in Kenya, as it seems it must, then plantations located farthest inside natural forests, particularly natural forests with wildlife fences around them, should (for a whole set of obvious biological, economic and practical reasons) be the first to be harvested and abandoned. Forest Department can more efficiently use its limited resources to regain control of, rehabilitate and properly maintain the many perimeter plantations which are currently unproductive as sources of forest products.

Mitigation Measures and Recommendations.

- There is concern that the Nyayo Tea Zone will be viewed by the local people as land that Forest Department and KWS no longer have an interest in protecting. This notion can be quelled by Forest Department and KWS by demonstrating their commitment to ensuring that the Nyayo Tea Zone be used for the purpose for which it was established; namely to serve as a buffer zone for the Forest Reserve. Forest Department and KWS should, therefore, undertake the following activities:
 - conduct a study to gather more data on the condition of the Nyayo Tea Zone. What might be done to increase the area within the Zone which is under productive tea? What are the best options for use of the unplanted parts of the Zone that will help ensure that it contributes as much as possible to the protection of the Forest Reserve.
 - ensure that all illegal activities on the Nyayo Tea Zone are stopped and that either tea is planted and grown on this land, or tree plantations are established;
 - permanently and clearly mark the east boundary of the Nyayo Tea Zone (i.e., boundary of the Forest Reserve). The most feasible, least expensive and probably most politically acceptable way of doing this is to plant a continuous live boundary of eucalyptus trees all along the outside (east) boundary of the Nyayo Tea Zone. Trees spaced 2 m apart should be adequate. Replanting will be required as these trees are destroyed or otherwise die. Once the trees are large enough, "Forest Reserve" signs should be securely placed on them at 100 m intervals.

- conduct an active conservation education/sensitization campaign among local communities, and promote and assist in improved conservation practices in the local communities (e.g., fuel efficient stoves, planting of woodlots).
- The Phase 5 area is one of Kenya's prime bird-watching and trout fishing areas. The southern parts of this area (e.g. , Gatamayu) can be reached within a 1 hour drive of several population centres, including Nairobi. These activities could be much more developed, particularly through community-based tourism development projects. Such opportunities for community development will be lost if the forest and watershed are not conserved.
- Reports were received during this survey of Forest Department officials in the Phases 5 and 6 areas taking money illegally from people so that the people would be allocated farm plots within the Forest Reserve, or so that they could take forest products illegally from the Forest Reserve. Observations on what is happening on the ground, such as the continued cutting of large numbers of indigenous trees and apparent encroachment, tend to support these accusations. An independent investigation is needed to determine whether or not these allegations are true.

17.6 COMMENTS

The EIA report for the ANRDP (FAO, 1997) states, "The deeply-incised, numerous rivers and high rainfall of this area will make the fence difficult to construct and maintain in this section. Fence construction across large rivers is unrealistic. It is unlikely that access for fence maintenance can be ensured all year round." This statement would apply better to the Phase 4 fence than to the Phase 5 fence. While there is some very rugged ground at the north end of Phase 5, the remainder of the Phase 5 fence is over some of the least difficult terrain to be found around the perimeter of the Aberdares Conservation Area. Also, although there are many rivers in this region, none of them is especially large. If the engineers and builders can successfully put the electric fence across the Chinya and Gura Rivers of Phase 4 they are expected to be able to do so across the lesser rivers and river valleys of Phase 5.

The EIA report for the ANRDP (FAO, 1997) suggests that the existing game moats in the Phase 5 area be rehabilitated and maintained. As pointed out in Sections 4.4.1 and 7.4, game moats (at best) only do one-half of the job that needs to be done so that the Aberdares ecosystem might be saved from further damage. Moats can sometimes, and with considerable expense, keep out wildlife. Most importantly, they are ineffective at

controlling human exploitive activities. People cross moats without difficulty (and easily move forest products and their livestock across). Moats in the Phase 5 area are particularly ill-advised as this is an area where the human-wildlife conflict is not nearly as serious a problem as is the uncontrolled and illegal removal of forest products by people. If there is one area around the Aberdares where an electric fence out-merits a moat it is here in the Phases 5 area.

17.7 CONCLUSIONS

The placement of the Phase 5 fence along the boundary of the Forest Reserve for most of its length should nearly eliminate the conflict between wildlife and those people growing crops outside of the Forest Reserve. This placement should also maximize the benefits to the southern part of the Aberdares Conservation Area, providing protection and control so that the conservation values of this area are enhanced.

See Section 16.7 for additional conclusions that apply also to the Phase 5 fence.

18. PHASE 6 FENCE

18.1 BACKGROUND TO THE FENCE

Note: The Phase 6 area and the Phase 5 area are broadly contiguous with each other. They are very similar in almost all respects. Most of what is said above concerning Phase 5 (Section 17) also applies to the Phase 6 fence and area.

Location. From the Mweri River (not Moedi River) at the southern tip of the Aberdares Forest Reserve northwards along the southwest side of the Aberdares Forest Reserve to the South Kinangop Forest Station Road at Njabini (Map 14).

Status. Placement of fence not yet decided by Forest Department and KWS. No activity on the ground.

Length. ca. 40 km (measured using Map-Info).

Purpose. To reduce the level of human-wildlife conflict in the area, to minimize damage by wildlife to a large area of plantation, to protect a large and vital watershed, and to help save the most biologically diverse part of the Aberdares Conservation Area from further destruction and degradation resulting from severe over-exploitation and agricultural encroachment.

18.2 THE SOCIO-ECONOMIC ENVIRONMENT

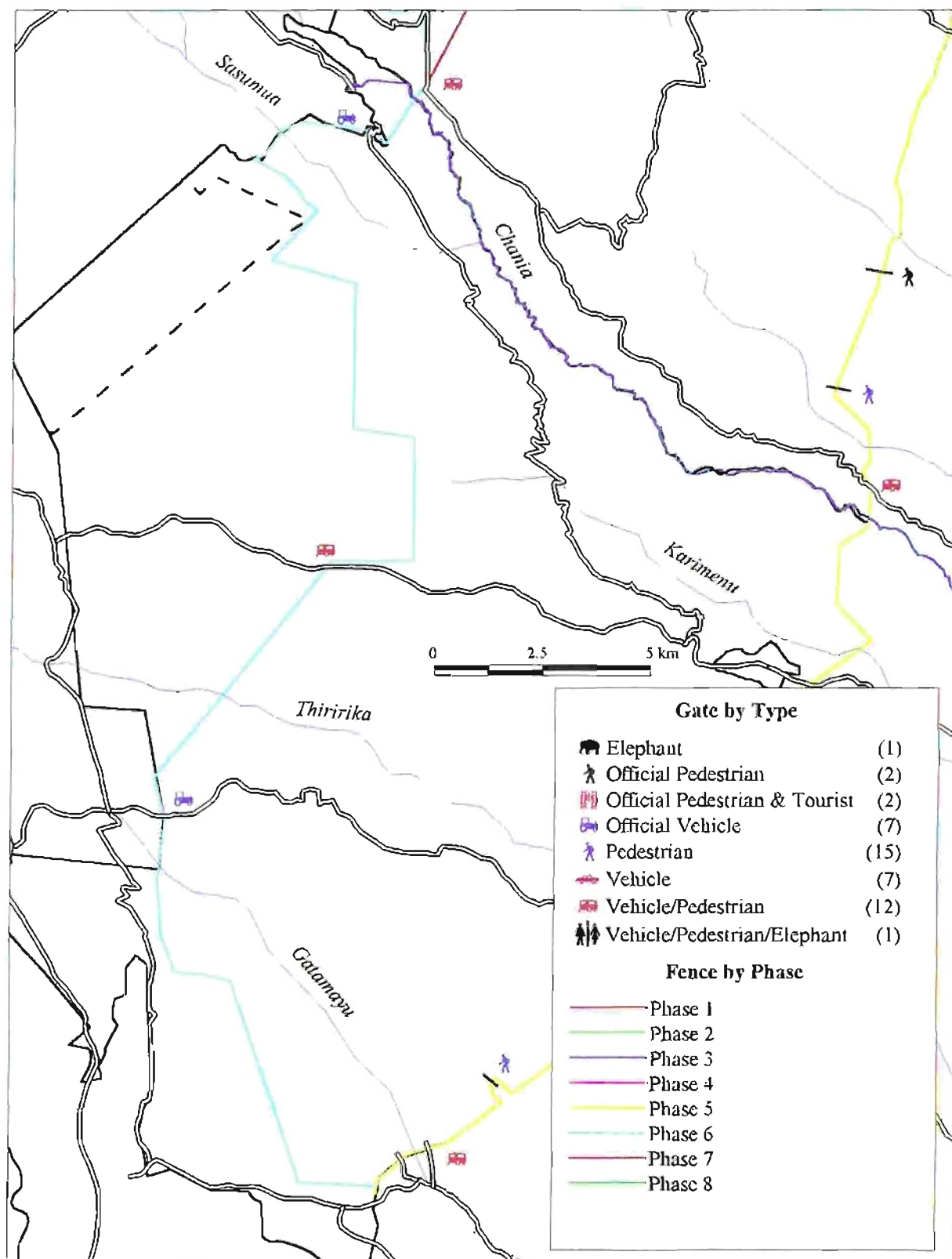
Human Population and Current Land Use

- Number of people interviewed: 21
- Population density near forest: relatively moderate.
- Mean size of farm plots: 1.5 ha.
- Main crops: maize, beans, potatoes, tea, livestock.
- Conservation Area: Farm plots up to and deep inside of Forest Reserve. Forest Reserve buffer zone all along boundary of National Park in the Phase 6 area.

Crop and Livestock Damage. Elephant, Sykes' monkey, porcupine, bushpig and antelope are the main problem species in the Phase 6 area. Buffalo are not important crop pests here as they seem to be in low densities. Baboons absent throughout.

Seventy-one percent of the people interviewed stated that they suffered a lot of damage to crops by wildlife (Appendix I).

Map 14. Recommended location of the Abardares Conservation Area Phase 6 fence and gates.



None reported damage to property by wildlife. Loss of livestock to wildlife rarely occurred. While there was considerable damage by wildlife to crops, it is important to note that most of this damage appeared to occur on illegal farm plots located within the Forest Reserve. There were few reports of wildlife causing damage outside of the Forest Reserve.

People here use loud noise, fire and dogs to deter crop-raiding wildlife.

Past and Current Use of the Natural Forest. Of the people interviewed, 86% said that they made much use of the Forest Reserve for fuelwood. Only a small number claimed to use the Forest Reserve for obtaining poles and lumber. Many, however, made use of the Forest Reserve for growing crops and grazing livestock. At least some people also use the forest for obtaining medicinal plants and water.

One big difference among the Phases 4, 5 and 6 areas, and the Phases 1, 2 and 3 areas is that there was no farming within the Forest Reserve in the Phases 1, 2 and 3 areas. As in all areas around the Aberdares where people graze livestock in the Forest Reserve, the people in the Phase 6 area own considerably more livestock than their individual plots can support.

As for Phase 5, the unregulated and illegal over-exploitation of Forest Reserve resources is common in the Phase 6 area. Grazing livestock were frequently observed within the Forest Reserve, as was the removal of poles, charcoal, fuelwood and lumber. For example, we observed several charcoal pits, a pile of 50 Ocotea usambarensis (camphor) boards, and a pile of over 100 building poles. Damage to the natural forest was particularly extensive within 2 km of the boundary, but was evident through. The forest here appears to have been creamed throughout of its most valuable hardwoods (e.g., Ocotea usambarensis).

No permits seem to have been issued for the taking of forest products...which were removed openly and, with a few exceptions, without interference from Forest Department personnel.

Most serious is the widespread encroachment within the Forest Reserve, particularly in the Kamae and Kieni Plantations. There is intensive cultivation along the western one-half of the Thika-Naivasha Road. People have been farming some of these plots for over 5 years, yet there is little evidence that trees are being planted and tended. Also of great concern is the construction of several permanent private shops at the entrance to the Kieni Forest Station.

There is encroachment elsewhere within the Forest Reserve in the Phase 6 area. For example, in the Kereita Plantation. People cultivating in this plantation state that they pay a standard

fee of KShs 120 per year to cultivate plots of 0.2-0.4 ha. All respondents said, however, that it was first necessary to pay the Forester personally KShs 3,000-4,000 per year to receive a plot. We were unable to confirm this. We saw little evidence that the people cultivating in this plantation were planting trees.

Just off the west boundary of the Kamae Plantation lies the 35.2 km² Kinale (Kinari) Excision. This area of Forest Reserve was encroached upon by 13,000 people. It was degazetted and excised from Kenya's forest estate in 1988 and the land given over to the encroachers. To the NW of the Kamae Plantation lies the Ragia Area. This 19 km² area has also been encroached upon by farmers, settled, and the trees removed. The Ragia Area is currently proposed for excision. This region of the Aberdares, thus, has a history of loss of Forest Reserve land to farmers. The farmers gained access to the Forest Reserve through the Shamba System, plant few if any trees, refuse to leave, and then demand that the land be given over to them. It now appears that the Kamae and the Kieni Plantations are threatened with a similar fate.

A large part of the Kikuyu Escarpment was once covered with wet evergreen montane forest. Due to clearing of this forest for crops and plantations, all that remains is a fragment of what once was. Even this fragment, which lies between the proposed Phase 5 and Phase 6 fences, is now seriously threatened. As with the Phases 4 and Phase 5 areas, the level of degradation of the forest in the Phase 6 area is extensive and is expected to worsen given the obvious lack of control.

There are several small forest reserves to the south and west of the Phase 6 area. To the south lie the Nyamwero and South Kikuyu Escarpment Forest Reserves which were mentioned in Section 17. To the west are the Magumo North (ca. 2 km²), Magumo South (ca. 3 km²), Kijabe Hill (ca. 6 km²) and West Kikuyu Escarpment (ca. 26 km²) Forest Reserves. Of these, only the West Kikuyu Escarpment Forest Reserve holds natural forest. As such, the Aberdares are the only source of natural forest products in this region for the vast majority of the people. A fair number of the people in the Phase 6 area grow at least some exotic trees for poles and firewood.

Attitudes Towards the Fence. Seventy-one percent of the people interviewed said that they were happy about the Phase 5 fence. The remaining 29% were neutral towards the fence. While these respondents understood that the fence would greatly limit the level of illegal exploitation of the Forest Reserve, they were positive about the potential reduction in damage by wildlife.

18.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. The terrain is moderately to slightly hilly over the area recommended for placement of the Phase 6 fence (Map 5). The topography here is very suitable for the construction of an electric fence. Since the rivers flow from west to east in this part of the Aberdares, the rivers in the Phase 6 area are much smaller than in the Phase 5 area. The major rivers in the Phase 6 area are Mweri, Sasumua, and Chania.

The elevation of the boundary of the Forest Reserve along Phase 6 varies from ca. 7,300 ft at the Mweri River Sykes' the Phase 6 fence begins, to ca. 8,500 in the middle stretch near Kinale and at the end of the road to the South Kinangop Forest Station. Soil fertility in the Phase 6 area is moderately high.

Rainfall. Mean annual rainfall over the Phase 6 area varies from ca 1,600 mm in the south to ca. 1,300 mm in the north (Map 7).

18.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Phase 6 lies in the "Montane Rain-forest Zone" (Hedberg, 1951). Phase 6, together with Phase 5, includes most of the "Wetter Evergreen Forest" found in the Aberdares. By far the largest block of wet evergreen forest above 7,200 ft (ca. 55 km²) in the Aberdares lies within the Phase 6 area. With the possible exception of the lower wet evergreen forest in the neighbouring Phase 5 area, the forest of the Phase 6 area are the richest in the Aberdares in terms of numbers of species.

Ten tree belt-transects were run in Phase 6 (Table 10). A mean 9.5 species of trees, and a mean 81.4 stems were found per transect. Tree species richness and density of stems were higher here than for any other phase in the Aberdares. The five most common trees found along transects in the Phase 6 area were Juniperus procera (14% of stems), Macaranga kilimandscharica (12%), Neoboutonia macrocalyx (11%), Nuxia congesta (10%), and Podocarpus latifolius (10%). These five species accounted for 57% of the stems.

Plantations and Excisions. The Phase 6 area has more area under plantation than any other Phase in the Aberdares. The six biggest plantations are the Kereita (ca. 14 km²), Ragia (ca. 7 km²), Kamae and Kieni (ca. 63 km²), Kimakia (ca. 19 km²), and South Kinangop (ca. 10 km²). Most of the mature trees in these plantations have been harvested, the harvesting continues, and little replanting is taking place. There are large areas in the plantations which are without trees. Most roads through these plantations are in poor condition and many are no longer

passable. The Ragia Plantation was an exception. In contrast to all other plantations seen in the Phase 6 area, or in the Phases 1-5 areas, the Ragia Plantation looked well-managed and productive, with reasonably well maintained roads.

There is much damage by elephants to exotic trees in the Phase 6 area. Trampling of vegetation in plantations and along roads by livestock is extensive in some areas of natural forest and in all of the plantations. This is having a negative effect on the regeneration of the natural forest.

As mentioned above, an excision of 35.2 km² was made in the Kinale Area in 1988 and an excision of ca. 19 km² has been proposed for the Ragia Area.

Birds. Thirty-nine species of birds were found along the 14 censuses conducted in the Phase 6 area (Table 19). The mean number of species found per census was 9.2. This is more species of birds per transect than for any other Phase. Ten species of birds were found only in the Phase 6 area and/or only in the broadly adjacent and similar forest of Phase 5 (Table 22. See Section 17.4 for more information on the birds of the Phase 6 area.

Large Mammals. Elephants and buffalo are widespread but in low densities throughout Phase 6 (Appendix IV). Bushpigs seem to be widespread and fairly common. Sykes' monkey and guereza are common throughout the area. Tree hyrax are present. Baboons are absent. Bushbuck and duiker are almost certainly present, but were not seen during this survey.

18.5 THE FENCE

Placement. The Phase 6 fence begins just north of where the Mweri River hits the boundary of the Forest Reserve near Kagwe (Map 14). Go due west 2.0 km and into the Kereita Plantation. Then NW ca. 5 km in a straight or nearly straight line with plantation to the west and natural forest to the east. Then west ca. 1 km around the north end of the plantation to the boundary of the Forest Reserve near the Kagwe Carbacid Plant. Then north ca. 2.5 km between the plantation (to the west) and natural forest (to the east) to the SE boundary corner of the Kinale Excision. Then north ca. 1.3 km along the Kinale Excision boundary to the Kinale-Mundoro Road. Then another 1 km north along the Kinale Excision boundary. Then NE ca. 6 km to the Kieni Forest Station. Then north across the Thika-Naivasha Road. Then 2 km due east along the north side of the Thika-Naivasha Road. Then due north ca. 3.5 km to the north edge of the Kieni Plantation. Then west 1.5 km along north edge of Kieni Plantation (Map 14). Then due north 3 km to the Ragia Forest Station. Then WNW ca. 2 km to the SE boundary of the

proposed Ragia Excision. Then follow the Ragia Excision boundary NE ca. 1.5 km to the NE corner of the Ragia Excision. Then follow the Ragia Excision boundary NW ca. 2 km to the boundary of the Forest Reserve. Then follow the boundary of the Forest Reserve ca. 6 km to the water pipe at the Sasumua Dam. Then NE ca. 2 km to the Thika-Njabini Road, striking the road at 8,075 ft (2,460 m contour), which is where the road changes from a north-south direction to a NW-SE direction (Map 14).

This placement of the fence:

- Takes into full account the current Forest Department guidelines on where to place fence in Forest Reserves.
- Maximizes the amount of plantation that is outside of the fence. This minimizes both the level of human-wildlife conflict as well as the number of pedestrian gates required. Damage to plantations, crops and livestock outside of the fence will be minimal. Local communities will be able to meet their domestic needs for forest products largely from the plantations and the areas of natural forest which lie outside of the fence.
- Maximizes the amount of natural forest that is inside of the fence, providing maximum control and protection to this valuable, but currently damaged and vulnerable, natural resource.
- Minimizes the length of the fence. The placement proposed here results in a fence which is ca. 19 km shorter than that proposed by FAO (1994). This minimizes construction and maintenance costs, and the impact of the fence on the environment.
- Puts the fence through the edges of plantations as much as possible, thus minimizing the clearing of indigenous forest for the fence-line.
- Ensures that nowhere in the southern one-third of the Aberdares Conservation Area is the north-south corridor [i.e., distance between the east (Phase 5) fence and the west (Phase 6) fence] less than 10 km in width. This corridor should be adequate for the migration and dispersal of all species of plants and animals living in this region. The area of natural vegetation enclosed by the fence Phases 5 and 6 fences (ca. 285 km² of which ca. 230 km is wetter evergreen forest) is probably large enough to ensure that there is adequate habitat to support most, perhaps all, of those plant and animals species confined to the wet evergreen forests of the southern Aberdares.

- Puts ca. 30 km² of plantation within the fence (if the Kimaki Plantation, but not Gatare Plantation is included in this calculation). Most of this plantation area is poor quality enclosed plantation that has been either poorly maintained, or else harvested and not replanted. All plantations placed within the fence should be harvested and abandoned prior to the construction of the fence. See Section 17.5 a discussion on why the Kimaki and Gatare Plantations should be included within the fenced area.

The forest in the Phase 6 area is of particular importance to the conservation both of this high rainfall watershed and of the region's biodiversity. The extreme over-exploitation of the forest here suggests that the only way that Forest Department will gain control of the natural forest, and allow for the natural forest to recover is through the construction of a fence.

Infrastructure and Gates. Access to the proposed fence-line is relatively good throughout. This is because (1) ca. 90% of the Phase 6 fence runs through or on the edge of plantations, (2) the terrain is relatively gentle, and (3) there are a good number of roads to the boundary of the Forest Reserve and through the plantations.

Outside of the fence there are extensive plantations which, in some cases also include some natural forest (e.g., the Kereita, Ragia and Western Kikuyu Escarpment Plantations). If these area are properly managed, there will be little need for local people to enter the fenced natural forest to obtain products for local consumption. As such, the number of gates recommended for the Phase 6 fence is minimal.

Several of the logging roads into the Forest Reserve along Phase 6 are in poor condition and can no longer be driven. Also, most of them lead to areas where over-exploitation has occurred and, therefore, where additional exploitation should not occur anytime in the near future. This report, therefore, recommends that these roads be abandoned and that no vehicle gate be provided for such roads. Forest Department may, however, want to place vehicle gates "for official use only" where some of these roads meet the fence. These gates should be locked except when an official vehicle needs to enter.

This report recommends that only four gates be constructed along the Phase 6 fence: two vehicle/pedestrian gates and two official vehicle gates.

The proposed locations of these four gates are as follows:

- Kinale official vehicle gate. Located where the road from

Kinale Forest Station meets the fence. Vehicle access here for official vehicle only.

- Kieni vehicle/pedestrian gate. Located at Kieni Forest Station. Entrance here is primarily for the purpose of passing through the forest from west to east, gaining access to the natural forest for recreational purposes, and for exploiting the plantations. This is not a road to be used to gain entrance to the natural forest for the purpose of removing natural forest products.
- Water pipeline official vehicle gate. Located where service road for the Sasumua Dam pipeline meets the fence. Vehicle access here for official vehicle only.
- Thika-Njabini Road vehicle/pedestrian gate. Located where the fence crosses the Thika-Njabini Road (ca. 4 km SE along the road from the South Kinangop Forest Station). Entrance here is primarily for the purpose of passing through the forest from west to east, gaining access to the natural forest for recreational purposes, and for exploiting the plantations. This is not a road to be used to gain entrance to the natural forest for the purpose of removing natural forest products.

What is outside of the fence and justification: Outside (west) of the fence lies an area of moderately dense human settlement, crop land, grazing land, small areas of natural forest, and by far the largest area of exotic tree plantation within the Aberdares Conservation Area. The plantations outside of the fence are not now in a productive state and are heavily encroached by farmers in some places. Nonetheless, there remains ample materials within these plantations to meet local needs. Once Forest Department regains control of these plantations and has the capacity to manage them, they will meet the needs for forest products of people far beyond the local communities, create a large number of jobs, and provide an important buffer to the fence and natural forest within.

What is inside of the fence and justification: Within the fence lies some of Kenya's most diverse wet evergreen montane forest. Although heavily logged and severely degraded, this forest continues to have high conservation values, both for watershed protection and species conservation. With protection and proper management, this forest will recover with time, and its watershed and species conservation values further enhanced.

The large Kimakia Plantation lies within the fence and is surrounded by montane forest. This plantation has been largely harvested or burnt, elephant damage to the exotic trees is high, there has been little replanting or maintenance of the plantation for some years, and the buildings and roads are either in poor condition or unusable. As with plantations

generally, the biological values of Kimakia Plantation is low compared to the surrounding natural forest.

As mentioned under Section 17.5, the Kimakia Plantation and the contiguous Gatere Plantation to the east are, for at least three reasons, poorly located in terms of conservation of the wet evergreen forest of the Aberdares ecosystem. First, ca. 28 km of species-rich natural forest were destroyed in order to establish these two plantations. Second, they lie in the centre of the vital corridor which connects the main block of the Aberdares Conservation Area to the biologically rich southern one-sixth of the Conservation Area. Thirdly, these two plantations allow for large numbers of people to enter deep within the Conservation Area to exploit forest products, often both unsustainably and illegally.

During this survey, consideration was given to the possibility of placing the fence so that it excluded all or most of the Kimakia and Gatere Plantations. The reasons for rejecting this are given in Section 17.5.

As mentioned in Section 17.5, one of the most important and strongest recommendations of this report is that the exotic trees in the Kimakia and Gatere Plantations be harvested, and that these two plantations then be abandoned and the area allowed to revert back to natural forest. This action would (1) greatly reduce the costs of constructing and maintaining the Phase 6 fence, (2) be the best possible situation for biodiversity and watershed conservation in the southern Aberdares, and (3) allow Forest Department to focus its limited resources on making the extensive "perimeter plantations" and the unplanted parts of the Nyayo Tea Zone of the Aberdares Conservation Area more productive.

Positive Impacts.

- Damage to crops by elephant, Sykes' monkey, bushpig and other wildlife will be greatly reduced by the fence, and thus also the level of human-wildlife conflict. This damage will not only be much reduced on the crop lands, but also over an extensive area of plantation.
- Construction and maintenance of the fence, and rehabilitation of the large area of plantation, will bring many new jobs to the area.
- The fence will do much to help protect Kenya's most critical watershed and one of the nation's most important sites for the conservation of biodiversity. With the fence, eventual recovery of this damaged portion of the Aberdares ecosystem is expected to occur. See Section 17.5.

- As areas of old growth return to the wet evergreen montane forests of the southern Aberdares we can expect some species to increase in numbers and distribution. See Section 17.5.
- Poaching will be considerably reduced by the presence of the fence. Populations of the more heavily hunted species, such as francolin, guinea fowl, duikers, bushbuck and buffalo are expected to increase.
- Around most of the Aberdares, there is virtually no habitat outside of the Aberdares Conservation Area that is suitable for wildlife. This is particularly the case for the southern two-thirds of the Aberdares. It is vital, therefore, that the fence not restrict the movement or distribution of wild species. Just the opposite is expected to occur with the placement of the Phase 6 fence that is recommended here. Extensive human activity within the Conservation Area and large areas of plantation restrict the movement and distribution of wild species, and the area of habitat available them. The fence will significantly reduce these problems, providing wild species with greater freedom of movement and more habitat (as natural habitat replaces plantation).

Negative Impacts. The usual negative impacts of placing an electric fence through montane forest (e.g., damage to natural vegetation, soil erosion), will be much less along the Phase 6 fence than along the other Phases of this fence. This is because (1) the terrain here is relatively flat, and (2) because ca. 90% of the fence-line passes through plantation rather than through natural forest. Probably the biggest negative impact will be on the people who have been illegally removing products from the Phase 6 area. This impact is not expected to be too severe, however, as there is ample forest produce in the plantations for domestic use, and both the fence and the rehabilitation of the plantations are expected to create work which these people can be hired to do. The expansion and better management of the forest reserves to the west, and of private woodlots can also be promoted to help meet the growing demand for forest products.

Elephant damage to the plantations located within the fence will probably increase. As pointed-out above, however, these plantations have already been largely harvested, are not being replanted, and continue to be poorly managed and protected. Forest Department does not have the capacity to properly manage all of its plantation land and is unlikely to have such capacity in the foreseeable future. If "plantation triage" is to be practiced in Kenya, as it seems it must, then plantations located farthest inside natural forests, particularly natural forests with wildlife fences around them, should (for a whole set of obvious biological, economic and practical reasons) be

the first to be harvested and abandoned. Forest Department can more efficiently use its limited resources to regain control of, rehabilitate and properly maintain the many perimeter plantations which are currently unproductive as sources of forest products.

Mitigation Measures and Recommendations.

The Phase 6 fence area is one of Kenya's prime bird-watching and trout fishing areas. Bird watching is excellent along old logging roads that run to either side of the Thika-Naivasha Road, and trout fishing is good in the nearby Karimenu River. The Chania River, in the north part of the Phase 6 area, is one of Kenya's most famous rivers for trout fishing. These sites can be reached within 1.5 h from Nairobi and several other population centres. These activities, together with hiking, back-packing and camping, could be much more developed, particularly through community-based tourism development projects. Such opportunities for community development will be lost if the natural forest and watershed are not conserved.

18.6 COMMENTS

The EIA report for the ANRDP (FAO, 1997) states:

- Baboons are a "major cause of human-wildlife conflict" in the Phase 6 area. This study found that there are no baboons in the Phase 6 area.
- The fence placement recommended here will fence out "a significant area of indigenous forest". The placement of the fence recommended by this study fences out less than 3% of the indigenous forest and all of this is badly degraded and intermixed with agriculture and plantation.
- "Encroachment of permanent cultivation into the plantation zone and illegal tree felling appear to be particular problems in this section.". FAO (1997) then recommends the rehabilitation of game moats in lieu of constructing an electric fence. As this study notes in Sections 4.4.1 and 7.4, game moats are not barriers against encroachers or pit-sawyers, and their construction is not recommended where control of access by local communities is needed to help ensure sustainable use of the Forest Reserve. Another point to make here is that it appears that the main function of the current moat in the Kieni Plantation of the Phase 6 area is to protect from wildlife the crops of long-term agricultural encroachers.

Here is another area, like that described at the north end of Phase 4 (i.e., the Kabage and Zaina Plantations), where people

have been cultivating deep within the Forest Reserve without planting or tending trees. Such illegal, unproductive and damaging activities within the Aberdares Forest Reserve should be removed...not sanctioned by moats.

18.7 CONCLUSIONS

The Phases 5 and 6 areas of the southern Aberdares represent two of Kenya's most important montane forest areas in terms of watershed and biodiversity conservation, and potential for the development of tourism and recreation. In addition, if sustainably used, these areas can someday, once again, provide a variety of important forest products both to local communities and to the nation. The Phases 5 and 6 areas are, however, heavily damaged by illegal and uncontrolled over-exploitation, and their conservation values have been reduced accordingly. This negative trend will undoubtedly continue if Forest Department and KWS are unable to regain control of exploitation. Placing a fence around the perimeter of what remains of the natural forest is probably the only way that the management authorities can effectively control, protect and manage the Phase 5 and 6 areas.

The placement of the Phase 6 fence at the interface between the natural forest and the plantations should nearly eliminate the conflict in this area between wildlife and Forest Department, and between wildlife and those people growing crops outside of the Forest Reserve. This placement should also maximize the benefits to the natural forest in the southern part of the Aberdares Conservation Area, providing protection and control so that the conservation values of this area are enhanced, and so that recreation and tourism can be encouraged and developed.

19. PHASE 7 FENCE

19.1 BACKGROUND TO THE FENCE

Location. From the Thika-Njabini Road north along the west side of the Aberdares Forest Reserve to the Chitohi River near the north gate of the Geta Plantation (Map 15).

Status. Placement of fence not yet decided by Forest Department and KWS. No activity on the ground.

Length. ca. 51 km (measured using Map-Info).

Purpose. To reduce the level of human-wildlife conflict in the area, to protect a large area of plantation, to protect a large and vital watershed, and to help save a large area of natural forest and critical wildlife habitat in the Aberdares Conservation Area from further destruction and degradation resulting from severe over-exploitation and agricultural encroachment.

19.2 THE SOCIO-ECONOMIC ENVIRONMENT

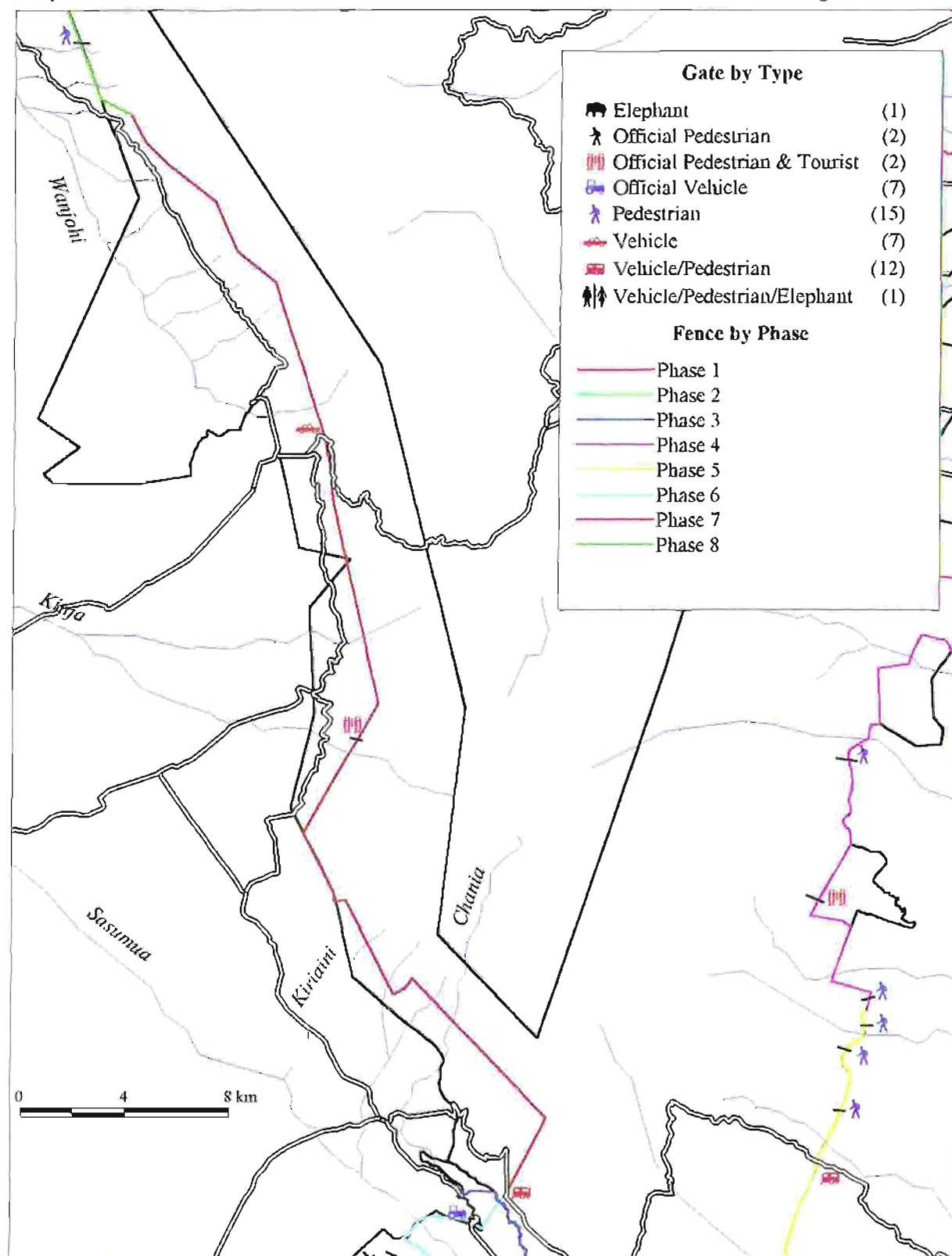
Human Population and Current Land Use

- Number of people interviewed: 126
- Population density near forest: relatively moderate.
- Mean size of farm plots: 2.9 ha.
- Main crops: maize, potatoes, peas, cabbage, carrots, livestock.
- Conservation Area: Farm plots up to and deep inside of Forest Reserve. Forest Reserve buffer zone all along boundary of National Park in the Phase 7 area.

Crop and Livestock Damage. Sykes' monkey and guereza are said to do the most damage in the Phase 7 area. Small amounts of damage are caused by elephant, antelope, porcupine, bushpig, lion, leopard and hyaena. Elephant and buffalo are uncommon here and not important crop pests. Baboons are absent throughout. This is the first area where guereza are considered to be a pest, but it seems most of the damage to crops by this species was confined to the leaves of potatoes. The local people did not consider this damage to be serious.

Thirty-nine percent of the people interviewed stated that they suffered a lot of damage to crops by wildlife (Appendix I). Except for the Phase 8 area, this is the lowest level of crop damage by wildlife reported for the Aberdares. Few people reported damage to property by wildlife, but a surprising 47% said they suffered a lot of damage to livestock from wildlife,

Map 15. Recommended location of the Abardares Conservation Area Phase 7 fence and gates.



mostly lion, leopard and hyaena. It is important to note that almost all of the damage to crops and wildlife occur on farm plots located within the Forest Reserve and on livestock grazed illegally in the Forest Reserve. There were few reports of wildlife causing damage outside of the Forest Reserve except to those plots right on the boundary.

People here used wooden or barbed wire fence, night-watches, dogs and fire to deter crop-raiding wildlife.

Past and Current Use of the Natural Forest. Of the people interviewed, 28% said that they made much use of the Forest Reserve for fuelwood. Only 8% claimed they made a lot of use of the Forest Reserve for poles, and only 3% made use of the forest for lumber.

Grazing and cultivation of the Forest Reserve was extensive in the Phase 7 area, and charcoal making and cutting of juniper poles are far more common here than anywhere in the Aberdares Conservation Area. A few people used the Forest Reserve for medicines, honey, bamboo and water. The unregulated and illegal over-exploitation of Forest Reserve resources is more common and extreme in the Phase 7 area than for any other area of the Aberdares. Exploitation and illegal use of the Phase 7 area were considerably greater north of the Mutubio West Gate than south of this gate.

As in all areas around the Aberdares where people graze livestock in the Forest Reserve, the people in the Phase 7 area own considerably more livestock than their individual plots can support.

Most serious is the widespread encroachment within the Forest Reserve, especially in the Geta and Kipipiri Areas. Here, an area of ca. 42 km² of natural forest has been destroyed and settled by farmers. Encroachers have now destroyed the corridor of forest between the Aberdares Forest Reserve and the Kipipiri Forest Reserve. There are now ca. 4 km of intensively cultivated and densely settled farmland separating these two Forest Reserves. In addition, that forest that does remain to the east and west of this encroached area is badly degraded. There are no other areas of natural forest remaining in the region of the Phase 7 fence. There is, however, a good number of exotic tree woodlots in this region.

The Geta-Kipipiri land situation is complicated, however, by the "Geta Settlement Scheme" of 1968. At that time, one or more government officials gave out 4 acre (1.6 ha) plots of Forest Reserve land to people. Forest Department officials refer to the Geta-Kipipiri farmers as encroachers and to the settlement scheme as illegal as the Forest Reserve here has not been degazetted.

Attitudes Towards the Fence. Eighty-five percent of the people interviewed said that they would be happy to see an electric fence in the Phase 7 area. Nearly everyone else interviewed was neutral towards the fence.

19.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. The terrain over which the proposed Phase 7 fence-line runs varies from fairly flat to moderately hilly and steep. The area above the fence-line and to the east is extremely rugged as here lies the west escarpment of the Aberdares (Map 5). The major rivers in the Phase 7 area are the Chania, Tulasha, and Mahisimi.

The elevation of the boundary of the Forest Reserve along Phase 7 varies from ca. 7,550 near the South Kinangop Forest Station at the south end of Phase 6 to 9,200 ft near Tulasha. It should be noted that a large area (the Geta Area) of Forest Reserve between 8,200 and 9,200 ft is encroached upon and that in this region the natural forest that remains only descends to the 9,200 ft level.

Soil fertility in the Phase 7 area is moderately high.

Rainfall. Mean annual rainfall over the Phase 7 area varies from ca 1,800 mm in the south to ca. 1,200 mm in the north (Map 7).

19.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Phase 7 lies in the "Montane Rain-forest Zone" (Hedberg, 1951). The south part of Phase 7 lies in the "Wetter Evergreen Forest" with bamboo at the higher elevations. The drier middle and north parts of Phase 7 are in the "Juniperus/Podocarpus/Olea" vegetation type. This last vegetation type is confined to the slopes and gives way to bamboo and then scrub near the top of the escarpment.

Twenty tree belt-transects were run in Phase 7 (Table 10). A mean 4.0 species of trees, and a mean 52.9 stems were found per transect. Tree species richness was low here, reflecting the low tree diversity usually associated with drier areas. The five most common trees found along transects in the Phase 7 area were Juniperus procera (28% of stems), Nuxia congest (18%), Olea europaea (18%), Elaeodendron buchananii (12%), and Olinia rochetiana (6%) (Table 12). These five species comprised 82% of the stems.

Plantations and Excisions. The Phase 7 area has a considerable area (ca. 55 km²) of plantations. Most of these are at the base

of the escarpment and within 2-3 km of the boundary of the Forest Reserve. The largest plantations are in the Geta-Nandarasi Area. Some of the best managed plantations in the Aberdares Forest Reserve are in the Njabini and Mutarakwa Areas. Many of the plantations, however, have been harvested and not replanted, and those in the Geta-Nandarasi Area are encroached upon. There is no doubt that, as elsewhere in the Aberdares, planting and tree growth have not kept up with harvesting. Most roads through these plantations are in poor condition and many are no longer passable.

There is considerable damage by elephants to plantations in the southern part of Phase 7, but almost no damage north of the Chania River. The likely reason for this is that elephants (and buffalo) are deterred from moving to this area from the higher ground of the Aberdares National Park by the extremely steep terrain (Map 5).

The only land excised from the Forest Reserve in the Phase 7 area is the Nyandarua Triange (ca. 3 km²). This area was excised in 1960.

Birds. Fifty-six species of birds were found along the 50 censuses conducted in the Phase 7 area (Table 19). The mean number of species found per census was only 6.5. This is the lowest number of bird species per census of any area of the Aberdares. Eight species of birds were found only in the Phase 7 area (Table 22). Most of these are known from other surveys to be present in other parts of the Aberdares, but of particular note here is the presence of green ibis Bostrychia olivacea in the Mutarakwa area.

Large Mammals. Elephants and buffalo are fairly common at the south end of Phase 7, but absent or only occasionally present near the boundary of the Forest Reserve to the north of the Chania River (Appendix IV). Sykes' monkey, guereza, bushpig, bushbuck, common (grey) duiker, black-fronted duiker, Egyptian mongoose, tree hyrax, lion, spotted hyaena, and crested porcupine were all present. We were told that there are no bongo in this area. Baboon are absent. Guereza were probably at higher densities at some places in the Phase 7 area (e.g., at Mutarakwa) than anywhere else in the Aberdares Conservation Area.

19.5 THE FENCE

Placement. The Phase 7 fence begins at the Thika-Njabini Road (Map 15). Then NNE ca. 3.5 km to the east-most point in the Njabini Plantation. Then NW ca. 8 km to 9,050 ft (2,760 m contour) on the Little Sasumua River. Then SW ca. 1 km down the south side of the Little Sasumua River to 8,850 m (2,700 m).

Then ca. 4 km to 8,900 ft (2,720 m contour) on the Tulasha River. Then west down the south side of the Tulasha River ca. 0.5 km to the boundary of the Forest Reserve. Then 2.5 km north along the boundary of the Forest Reserve. Then NE ca. 5.5 km to 9,100 ft (2,780 m contour) on the Laigiri River. Then NNW ca. 5.5 km to the east corner of the Nyandarua Triangle (9,050 ft, 2,760 m contour) continuing on in the same direction ca. 4.5 km to 8,650 ft (2,640 m contour) on the road to West Matubio Gate Road. Then NNW ca. 6 km to 9,840 ft (3,000 m contour) on the Gathathi River. Then NW ca. 8.5 km to 9,200 ft (2,800 m contour) on the Chitohi River. The fence-line between the Gathathi and Chitohi Rivers runs between the agricultural encroachment to the SW and the base of the steep slopes of the escarpment face to the NE. Here the fence-line will run close to the 9,200 ft (2,900 m) contour for about the first 7 km. The fence-line here should be as straight as possible and run as close to the edge of the cultivation as possible.

This placement of the fence:

- Ensures both that the fence-line goes over the least difficult terrain and that the largest possible area of natural habitat is within the fence.
- Takes into full account the current Forest Department guidelines on where to place fence in Forest Reserves.
- Helps to provide maximum protection to a narrow and fragile buffer zone between the local people (who are in many cases encroachers) and the National Park. In many places along the Phase 7 fence the fence-line is only 1.5-3 km from the boundary of the National Park, and at Geta the local community (and fence-line) are less than 2 km from the boundary of the National Park.
- Maximizes the amount of plantation that is outside of the fence. This minimizes both the level of human-wildlife conflict as well as the number of pedestrian gates required. Damage to plantations, crops and livestock outside of the fence will be minimal. Local communities will be able to meet their domestic needs for forest products largely from the plantations and the areas of natural forest which lie outside of the fence.
- Maximizes the amount of natural forest that is inside of the fence, providing maximum control and protection to this valuable, but currently damaged and vulnerable, natural resource.
- Puts the fence along the edges of plantations as much as possible, thus minimizing the clearing of indigenous forest for the fence-line.

Infrastructure and Gates. Access to the proposed fence-line is relatively good throughout. This is because (1) ca. 90% of the Phase 7 fence runs through or on the edge of plantations, or on or close to the boundary of the Forest Reserve, and (2) there are a good number of roads to the boundary of the Forest Reserve and through the plantations or encroached area.

Outside of the fence there are extensive plantations which also include ca. 12 km² of natural forest. The forest outside of the fence, if properly managed and used sustainably, will meet the needs of the local people for forest products. The only part of the fence-line where people near the fence will not have ready access to established plantations is in the ca. 42 km² encroached area at Geta. The encroachers here already live up to 10 km within the Forest Reserve, already have unlimited access to 42 km² of Forest Reserve land, and have already taken more than their share of Forest Reserve resources. They should not be given access to what little natural forest remains within the fenced area of Phase 7.

In short, there will be little need or justification for local people to enter the fenced natural forest to obtain products for local consumption. As such, the number of gates recommended for the Phase 7 fence is minimal. This report recommends that only two gates be constructed along the Phase 7 fence: one official and tourist pedestrian gate, and one vehicle gate.

The proposed locations of these two gates are as follows:

- Sanga Ridge official & tourist pedestrian gate. Located where the old Mutarakwa-Sanga Ridge Road meets the fence. This former road is now a footpath that leads to the firetower on the Sanga Ridge and continues on to the Kinangop peaks. This is the main hiking trail from the west to the Kinangop peaks.
- Mutubio West park vehicle gate. Located where Naivasha-Nyeri Road strikes the fence. This is the main road into the National Park from the west, as well as from the Lake Naivasha area on the west to the Nyeri area on the east.

What is outside of the fence and justification: Outside (west) of the fence lies an area of moderately dense human settlement, crop land, grazing land, ca. 12 km² of natural forest, and a fairly large area of exotic tree plantations. Some of the plantations outside of the fence are not now in a productive state, having been harvested or burnt and not replanted. Nonetheless, there remains ample materials within these plantations to meet local needs. Once all of the plantations are again productive, they will meet the needs for forest products of people far beyond the local communities, create a large number of jobs, and provide an important buffer to the fence and natural forest within.

The Kipipiri Forest Reserve (50.8 km²) is part of the Aberdares Conservation Area but will lie outside of the Phase 7 fence. This Forest Reserve is encroached over a large area and seriously degraded. Nonetheless, Kipipiri still hold a significant area of natural forest. If sustainably used, Kipipiri Forest Reserve would do much to meet the needs of the local people for natural forest products and, thus, serve as an important buffer to the forest of the Aberdares Conservation Area. In addition, Mt. Kipipiri rises to 11,160 ft (3,400 m) and, therefore, is a vital watershed for the drier areas to the north and west. Kipipiri Forest Reserve represents the largest area of natural forest in the region which will not be within the fence.

Outside of the Phase 7 fence are ca. 42 km² of encroached Forest Reserve that lie between 8,200 and 9,200 ft. The thousands of encroachers here have already destroyed a large part of the natural ecosystem of the Aberdares, are living outside of the laws of Kenya, and are a proven threat to the integrity and sustainable utilization of the Aberdares Conservation Area, having destroyed the natural forest up to an elevation of 9,200 ft (2,900 m). Not only have they destroyed ca. 42 km² of Kenya's valued juniper and olive forest and damaged the watershed, they have reduced the width of Forest Reserve buffer zone to the National Park to a width of ca. 2 km.

What is inside of the fence and justification: Within the fence lies badly degraded forest on steep slopes. This forest is important to watershed protection. With protection and proper management, this forest will recover with time, and its watershed and species conservation renewed. Also within the fence are ca. 5 km² of plantation. Most, perhaps all, of this plantation area is poor quality peripheral plantation that has been either poorly maintained, or else harvested and not replanted. All plantations placed within the fence should be harvested and abandoned prior to the construction of the fence.

Positive Impacts.

- The natural forest in the Phase 7 area is of particular importance to the protection of soils on the steep slopes here and for protection of the watershed upon which a large number of people living in the drier region to the west depend. The large-scale destruction of the natural forest in the Phase 7 area, and its extreme over-exploitation suggest that the only way that Forest Department will gain control of the natural forest, and allow for the natural forest to recover, is through the construction of a fence.
- Damage to crops by elephant, Sykes' monkey, bushpig and other wildlife will be greatly reduced by the fence, and thus also the level of human-wildlife conflict. This damage will not

only be much reduced on the crop lands, but also over a large area of plantations.

- Construction and maintenance of the fence, and rehabilitation of the plantations, will bring many new jobs to this area.
- With the fence, eventual recovery of this damaged portion of the Aberdares ecosystem is expected to occur.
- Poaching will be considerably reduced by the presence of the fence. Populations of the more heavily hunted species are expected to recover.
- Frequent fire is a serious problem in the Aberdares, particularly in the drier west and north parts. Fire destroys valuable trees and wildlife, and prevents the forests from expanding into the grasslands. Virtually all of these fires are human-caused, probably mostly by poachers and herdsmen. The fence is expected to greatly reduce the incidence of fire.

Negative Impacts. One of the usual impacts of placing an electric fence through montane forest, damage to the natural vegetation, will be low along the Phase 7 because ca. 90% of the fence-line passes through plantation rather than through natural forest. Since the slopes here are fairly long and steep, erosion will be a problem which needs to be minimized.

Probably the biggest negative impact will be on the many people who illegally remove products from the Phase 7 area, particularly charcoal makers, and those who cut building poles and graze livestock. The availability of considerable plantation land and some natural forest outside of the fence will help to mitigate this impact, as will the creation of new jobs. In addition, woodlots can be encouraged and promoted to help meet the growing demand for forest products.

Elephant damage to the plantations located within the fence will probably increase. However, these plantations have already been largely harvested, are not being replanted, and continue to be poorly managed and protected. Abandoning these plantation will free-up Forest Department resources for use in removing encroachers from areas outside of the fence, and for rehabilitating and properly maintaining the more accessible perimeter plantations.

Mitigation Measures and Recommendations.

- The conservation of Kipipiri should be a major focus of the ANRDP. If the present conservation values of the Kipiriri Forest Reserve have not improved by the time the fencing programme for the main block of the Aberdares Conservation

Area is completed, then serious consideration should be given to also placing a fence around all or part of Kipiriri.

- Special mention should be made of the encroachers within the Forest Reserve along Phase 7 at Geta. This is, by far, the largest number of encroachers, and largest area encroached upon, anywhere in the Aberdares Forest Reserve. The number of encroachers is not known, but is unlikely to be fewer than 10,000. For the good of Kenya, Kenyans, and the Aberdares Conservation Area, all encroachers should be removed from the Aberdares Forest Reserve.

19.6 COMMENTS

The northern part of the Phase 7 area of the western Aberdares is under considerable threat from an array of illegal exploitive activities, from charcoal making to agricultural encroachment. The considerable potential that this area has for protecting this important watershed and for meeting the needs of the local people and the nation for forest products is now substantially reduced.

19.7 CONCLUSIONS

This is one of the regions of the Aberdares Conservation Area most in need of a fence, particularly in the Geta and Kipipiri areas where encroachment is widespread. The situation will continue to deteriorate until Forest Department and KWS are able to control exploitation. The fence, together with other conservation activities, is expected to make this possible.

20. PHASE 8 FENCE

20.1 BACKGROUND TO THE FENCE

Location. From the Chitohi River near the north gate of the Geta Plantation to the top of the cliffs to the north of the Malewa River (Map 16).

Status. Placement of fence not yet decided by Forest Department and KWS. No activity on the ground.

Length. ca. 14 km (measured using Map-Info).

Purpose. To reduce the level of human-wildlife conflict, conserve what little remains of the natural forest, and to protect the NW flank of the Aberdares National Park and a vital watershed that lies over the steepest terrain of the Aberdares (Map 5). The boundary of the Forest Reserve here is only 2-3.5 km from the boundary of the National Park.

20.2 THE SOCIO-ECONOMIC ENVIRONMENT

Human Population and Current Land Use

- Number of people interviewed: 19
- Population density near forest: relatively low.
- Mean size of farm plots: 5.9 ha.
- Main crops: maize, potatoes, cabbage, carrots, livestock.
- Conservation Area: Farm plots up to and inside of the Forest Reserve. Forest Reserve buffer zone all along boundary of National Park in the Phase 8 area.

Crop and Livestock Damage. Sykes' monkey, guereza colobus, bushpig, leopard, hyaena are said to do the most damage in the Phase 8 area. Elephant, buffalo, lion and baboon are absent.

Only 5% of the those interviewed said that they endure a lot of damage to crops from wildlife and but 16% said that they lose a lot of livestock to wildlife (Appendix I). This is the lowest level of crop and livestock damage by wildlife reported for the Aberdares. As elsewhere around the Aberdares, the people reporting the highest levels of conflict with wildlife are those with farm plots and livestock located within the Forest Reserve. There is little damage by wildlife to crops or livestock outside of the Forest Reserve.

People use wooden or barbed wire fence, dogs, and scarecrows to protect their crops and livestock. They also hold livestock in pens at night.

Past and Current Use of the Natural Forest. Of the people interviewed, only 10% said they made much use of the Forest Reserve for fuelwood. Only 5% claimed they made a lot of use if the Forest Reserve for poles. Other uses were grazing, cultivation, water, lumber and charcoal.

This area appears to have the lowest human population density of any area around the Aberdares Forest Reserve. As such, the amount of land owned by the average family (5.9 ha) is considerably greater than for any other area. This encouraged the widespread establishment of woodlots of exotic trees. These woodlots seemed to meet most of the domestic needs of the local communities for forest products. This said, there are areas, such as Mikeu (Gathore) near the Wanjohi Settlement, where there is extensive removal of juniper poles, timber and charcoal from the Forest Reserve for commercial purposes. As with the Phase 7 area, all of the forest seen in the Phase 8 area is badly degraded and must be considered secondary. Also, at Gathore, there is an area (ca. 2.4 km²) of destroyed natural forest and agricultural encroachment between the boundary of the Forest Reserve and where the steep ground (ca. 45 degree slope) abruptly starts (00° 21.09"S & 36° 33.12"E, 8,630 ft) (Map 5). Much of this encroachment is said to be controlled by a commercial carrot producer who Forest Department has unsuccessfully attempted on a number of occasions to remove from the Forest Reserve. It is likely that all of the people growing crops on this land have ample land-holdings outside of the Forest Reserve. Mr. Matu Mururu is the person who Forest Department officials claim is the leader of this group of encroachers.

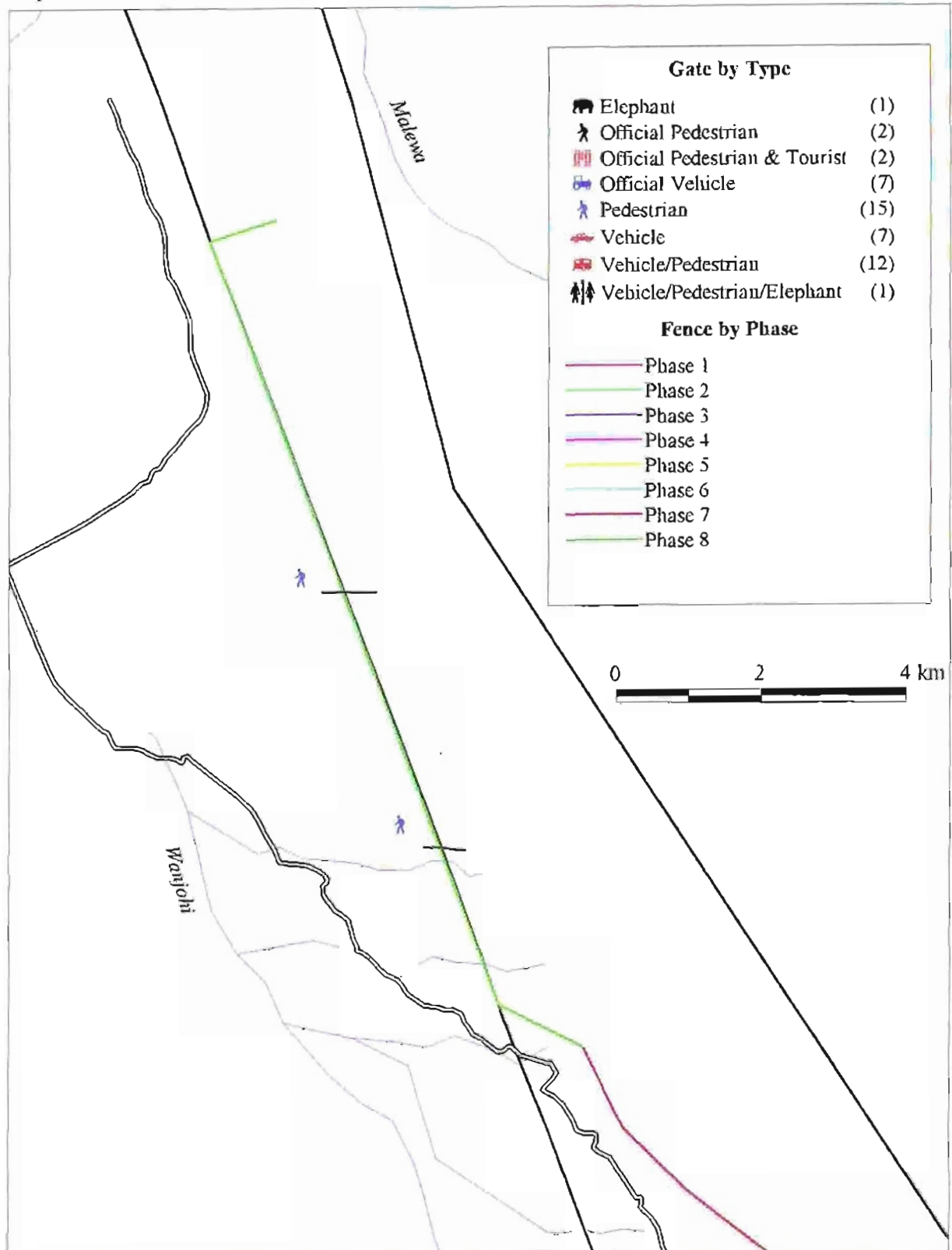
Grazing within the Forest Reserve is common throughout, as is the making of charcoal. In fact, charcoal making is much more prevalent within the Forest Reserve of the Phase 7 and 8 areas than anywhere else within the Aberdares Conservation Area. At the Rayetta Forest Station, where there are two Forest Guards, there is massive taking of indigenous trees for charcoal within 300 m of the Station.

Attitudes Towards the Fence. Ninety-five percent of the people interviewed said that they would be happy to see an electric fence in the Phase 8 area. Everyone else interviewed was neutral towards the fence.

20.3 PHYSICAL ENVIRONMENT

Topography, Hydrology and Soil Fertility. The terrain over the

Map 16. Recommended location of the Abardares Conservation Area Phase 8 fence and gates.



Phase 8 area is fairly flat to the west along the floor of the Rift Valley, but gives way suddenly to extremely steep mountain-side to the east that rises-up to the highest point in the Aberdares at Oldonyo Lesatima (4,001 m) (Map 5). For example, along the Wanjohi River, the elevation rises nearly 2,200 ft (670 m) over a horizontal distance of just 2 km. At the Makuru and Malewa Rivers there are 600 ft (200 m) high cliffs. The boundary of the Forest Reserve lies on fairly flat ground from the southern end of Phase 8 at the Chitohi River for about 14 km to the Njangiri River, north of which the ground rapidly becomes steeper up to the Malewa River.

The major rivers in the Phase 8 area are the Kitai, Wanjohi, Njangiri, Makuru and Malewa. Much of the water from this watershed flows into Lake Naivasha.

The elevation of the boundary of the Forest Reserve along Phase 8 varies from ca. 8,200 - 8,450 ft for most of its length but rises sharply to 9,100 to the top of the cliffs of the Malewa River Canyon at the north end.

Soil fertility in the Phase 8 area is high to moderately high.

Rainfall. Mean annual rainfall over the Phase 8 area ranges from ca 1,200 mm in the north to ca. 1,400 mm in the south (Map 7).

20.4 BIOLOGICAL ENVIRONMENT

Natural Vegetation. Phase 8 lies in the "Montane Rain-forest Zone" (Hedberg, 1951). The vegetation type here is "Juniperus/Podocarpus/Olea". This gives way to a large area of scrubland above ca. 10,500 ft. Fires are common in the scrubland. Natural forest does not go farther north than 00 17.26'S on the west side of the Aberdares. Rather dry, windy conditions at these high elevations (>8,500 ft) favour frequent fires and these have probably prevented the establishment of natural forest in the north part of the Phase 8 area.

Four tree belt-transects were run in Phase 8 (Table 10). A mean 6.5 species of trees, and a mean 24.8 stems were found per transect. Stem density was low here, reflecting both the loss of trees due to exploitation and the relatively dry conditions. The five most common species of trees found along transects in the Phase 8 area were Olinia rochetiana (22% of stems), Nuxi congesta (17%), Dombeya torrida (17%), Juniperus procera (12%) and Maytenus heterophylla (11%) (Table 12). These five species comprised 80% of the stems.

Plantations and Excisions. There are no plantations or known excisions in the Phase 8 area. This is probably because there

is not much flat or gently sloping ground within the Forest Reserve, and because of the high threat of fire.

Birds. Twenty-one species of birds were found along the seven censuses conducted in the Phase 8 area (Table 19). The mean number of species found per census was 7.1. This is the second lowest number of bird species per census of any area of the Aberdares.

Large Mammals. As mentioned above, elephant, buffalo, lion and baboon are probably absent from the Phase 8 area (Appendix IV). Sykes' monkey and guereza were observed during this survey, while bushpig, leopard and spotted hyaena are said to be present.

20.5 THE FENCE

Note. The Phase 8 area is the only one of the eight fence phases for which this survey recommends that other approaches to conservation be tried first. There are two primary reasons for this recommendation.

First, this is the area adjacent to the Aberdares where the level of human-wildlife conflict is lowest. This is almost certainly due to the fact that the area of natural forest here is represented by only a 1-2 km wide strip, and that the entire area is flanked to the east by cliffs and very steep ground. This means that there is now little suitable habitat for large mammals such as elephant and buffalo. It also means that large mammals have great difficulty moving in and out of this area due to the barrier presented by the steep terrain (Map 5). Thus, one of the two main reasons for building a fence (*i.e.*, to reduce the level of human-wildlife conflict) is not present in the Phase 8 area.

Second, if it is possible for Forest Department and KWS to regain control and instil sustainable utilization to any part of the Aberdares Forest Reserve it is in the Phase 8 area. There are several reasons for this:

- The fewer the people, and the lower the population density, the easier local communities should be to work with. The Phase 8 area has the lowest population density of any area around the Aberdares.
- Human activities in small areas are easier to manage than in large areas. Phase 8 is only ca. 14 km in length and holds only ca. 17 km² of natural forest.
- People with large holdings of fertile land put less pressure on Forest Reserves than do people with little or no land.

The mean size of farm plots in the Phase 8 area is twice that of most regions around the Aberdares and the soils here are probably the richest.

- The more forest produce that can be grown outside of the Forest Reserve the less pressure on the Forest Reserve. There is much flat, fertile land in the Phase 8 area which can be used for establishing woodlots.

In a sense, the Phase 8 area can be used as a "test area" on which to try approaches other than fencing for removing encroachers and controlling exploitation of forest products. These might include establishment of more woodlots on private land, increased use of fuel efficient stoves, more environmental education and sensitization in the local communities, increased frequency of patrols by Forest Guards and KWS Rangers, "self-policing" systems among the local people, greater and stronger involvement of government officials in removing encroachers, etc. If "conservation tools" other than fencing are not effective in the Phase 8 area, then they are unlikely to be effective when applied without the aid of a fence in any of the other seven phases, all of which have higher levels of human-wildlife conflict and greater pressure from local communities on the natural forest.

Since the Phase 8 area is the lowest priority area for the Aberdares wildlife fence, and since it is likely to take at least a decade before the other seven phases of the fence are constructed, there is time to apply and test other approaches to conservation in the Phase 8 area. If by the time the other seven phases of the wildlife fence are constructed there is not sufficient progress by Forest Department and KWS towards the control and sustainable utilization of the Phase 8 area, then the fencing of the Phase 8 area should proceed using the placement recommended here.

The following evaluation and recommendations are provided in the event that other approaches fail and Phase 8 does require a fence.

Placement. The Phase 8 fence begins at the 9,200 ft (2,800 m contour) on the south side of the Chitohi River (Map 16). Then WNW ca. 1 km along the south side of the Chitohi River to the Geta Gate on the boundary of the Forest Reserve. Then NNW along the boundary of the Forest Reserve ca. 12 km to the Mukuru Dairy. Then ENE ca. 100 m to the face of the cliff.

This placement of the fence:

- Takes into full account the current Forest Department guidelines on where to place fence in Forest Reserves.

- Minimizes the length of the fence.
- Ensures both that the fence-line goes over the least difficult terrain and that the largest possible area of natural habitat is within the fence.
- Helps to provide maximum protection to the narrow, fragile, already damaged and vulnerable buffer zone between the local people and the National Park (the fence-line lies only 2-3.5 km from the boundary of the National Park).

Infrastructure and Gates. Access to the proposed fence-line is relatively good throughout, although the terrain becomes somewhat steep towards the north end. There are roads up to the fence-line over the first 8 km.

Two pedestrian gates are recommended, one ca. 3 km north of the Geta Gate and one on the small road ca. 0.5 km south of the Njangiri River. This placement of gates will mean that nobody who lives near the boundary will be more than 3 km from a gate. People living along the north end of the Phase 8 fence will have access to natural forest products in the Kirima Forest Reserve.

What is outside of the fence and justification: Outside (west) of the fence lies an area of relatively low density human settlement, rich crop land, and grazing land. There is no natural forest outside of the Forest Reserve here except for the ca. 2 km² Karima Forest Reserve at the north end of the fence. The Karima Forest Reserve should be used sustainably to provide natural forest products to the people living in that area.

What is inside of the fence and justification: Within the fence lies an area (Gathore) of encroachment (2.4 km²) on the floor of the Rift Valley, and then badly degraded forest on very steep slopes. With protection and time, the bare land will revert back to natural forest and the existing forest will recover, renewing the watershed and species conservation values of this part of the Aberdares Conservation Area.

Positive Impacts.

- The natural forest in the Phase 8 area is of particular importance to the protection of soils on the extremely steep slopes here and of the watershed upon which a large number of people living in the drier region to the west and south depend. For example, this is a major watershed for Lake Naivasha (via the Malewa River).
- Construction and maintenance of the fence, and rehabilitation of the plantations, will bring new jobs to this area.

- With the fence, eventual recovery of this damaged portion of the Aberdares ecosystem is expected to occur.
- Poaching will be considerably reduced by the presence of the fence. Populations of the more heavily hunted species will recover.
- Frequent fire is a serious problem in the Aberdares, and probably nowhere more so than in the Phase 8 area. It appears that the fires here, started by people on the lower slopes, frequently move upwards into the moorlands, burning enormous areas of the Aberdares during the drier years. The large area of species-poor shrubland in higher parts of the National Park in the Phase 8 area are probably derived and maintained by this frequent burning. The fence is expected to reduce the incidence of fire.

Negative Impacts. The fence-line will cause some damage to the soil and natural vegetation in the Phase 8 area. This damage will be minimal, however, as the natural vegetation has already been removed and soils disturbed over an area far greater than that of the fence-line.

Probably the biggest negative impact will be on those people who are now illegally removing products from the Phase 8 area, particularly the many charcoal makers, and those who cut building poles and graze livestock. The availability of considerable land for establishing woodlots outside of the Forest Reserve will help to mitigate this impact, as will the creation of new jobs.

Mitigation Measures and Recommendations.

The biggest challenge that Forest Department and KWS face for the proper management of the Phase 8 area is eliminating the encroachment. All encroachers need to be removed from the Aberdares Forest Reserve, including those in the Phase 8 area. Given the relatively large size of farm plots owned outside of the Forest Reserve, it is likely that all of the encroachers own land outside of the Forest Reserve. Also, there are no permanent structures (yet) on the encroached land. Therefore, if the political will is there, these two factors should make it a relatively easy matter to remove the encroachers and to keep them out.

20.6 COMMENTS

There are an array of conditions which indicated that the Phase 8 area should have lowest priority for construction of a wildlife fence, and that this is the area where the use of other approaches to conservation of the Aberdares Forest Reserve are

most likely to be successful. If other approaches to conservation of the natural forest do not work in the Phase 8 area, they are much less likely to yield positive results elsewhere around the Aberdares (where pressure on the Forest Reserve from the local communities is far greater). This report, therefore, recommends that conservation activities other than fencing be implemented in the Phase 8 area, but that construction of the fence should proceed if these fail to achieve the needed level of control and protection.

20.7 CONCLUSIONS

From a biodiversity standpoint, the Phase 8 area is probably the least important area in the Aberdares. As a watershed however, this appears to be one of the most important areas. As the area least in need of a fence at this time, the Phase 8 area offers those individuals and organizations that disapprove of the fence, or that are skeptical of the fence, a "test" site where other approaches to the conservation of the natural forest of the Aberdares can be implemented, experimented with, and demonstrated.

21. MONITORING PROGRAMME

For the Aberdares Conservation Area there is already a fairly good set of baseline data for trees (Appendix II), birds (Appendix III), primates and elephants (Appendix IV), and reasonably good information on the distribution of other large mammals. Here are some recommendations for a long-term monitoring program for the Aberdares.

21.1 Vegetation

Conduct additional vegetation surveys, particularly tree surveys, at sites where such surveys have been undertaken before (Nganga & Kamande, 1990; KIFCON, 1994; Ngoru, 1998; this study, Appendix II). In addition, permanent plots or transects should be established and marked at sites throughout the Aberdares Conservation Area. Counting and measuring trees with a dbh >10 cm once every 10 years should be adequate. A series of permanent vegetation plots, in which all species of plants are identified and counted, should be established relatively close to the existing and planned fence-line. For example, at distances of about 30 m, 200 m and 1,000 m from the fence-line. As these plots will be also assessing changes in the grass, forb and shrub components of the vegetation, they should always be during the same month of the year.

Detailed vegetation maps are critical both to the development of the ANRDP management plan and to long-term monitoring. High resolution aerial or satellite photographs of the entire ANRDP area (including the area 3 km out from the perimeter of the Aberdares Conservation Area) should be obtained at the beginning of this project, as should copies of the Landsat colour composites of 1976, 1980 and 1988 (Nganga & Kamande, 1990). The area should be photographed again about 10 years after the start of the ANRDP and a comparative analysis undertaken to assess change. Particular attention should be paid to the amount and distribution of natural forest and plantation forest within the 3 km wide "community conservation zone".

21.2 Large Mammals

Counts of dung piles of large mammals (e.g., elephant, buffalo, antelope, lion, leopard, spotted hyaena) along fixed transects located throughout the Aberdares should be conducted once every two years during a particular month. The middle of the long dry season (August) might be best. This should be supplemented with road side counts once every year in the more open habitats, particularly the moorlands and large glades of the northern part of the National Park. Dung counts and road side counts should

be standardized as much as possible so as to minimize the effects of time of day, time of year, number of counters, width of transect, speed of vehicle, etc . The goal should be to monitor trends and "relative" changes in numbers, rather than to attempt to obtain estimates on absolute population size.

21.3 Birds

Some information on the distribution of birds in and around the Aberdares is available from the Database of the Ornithology Department, National Museums of Kenya and from this report (Appendix III). The sites sampled during this study can be resampled using the same method as applied during this study. This should, however, be undertaken in conjunction with a mist-netting sampling program along fixed net lines. The mist-netting program should be conducted once every 1 or 2 years, and always at the same time of the year. March or April are probably the most suitable months as many species of birds are breeding at this time of year and, therefore, highly active. It is also the time of year when migrants are in passage through Kenya. As with the vegetation sampling program, the mist-netting should focus on sites fairly close to the fence so that the possible impact of the fence and other ANRDP activities on species diversity and abundance can be most effectively assessed.

21.4 Comments

Vegetation mapping and close monitoring of the above taxa should provide an excellent indication of the impact of the fence and other activities on the fauna and flora of the ANRDP area. Other taxa, particularly butterflies, large moths, small mammals and amphibians might also be monitored.

The data presented in Appendices I-IV of this report, together with the research undertaken prior to this study, provide a preliminary basis for monitoring the impact of the fence and of the other activities of the ANRDP on the conservation values of the Aberdares Conservation Area. The above provide some general guide-lines as to the kinds of research activities that should be included within the more comprehensive monitoring programme of the ANRDP. To provide more details on numbers and locations of data collection sites, on frequency of data collection, methods to use, etc. at this time is beyond the scope of this report. This should be done, as stated in FAO (1994), as part of the development of the management plan.

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