A NATIONWIDE SURVEY OF CROP-RAIDING BY ELEPHANTS AND OTHER SPECIES IN GABON

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INTRODUCTION

Gabon harbours one of the largest elephant populations in Africa. Barnes *eta!*. (1993) estimated that there are about 61,000 elephants in the country. The distribution of elephants in Gabon is greatly influenced by past and present human activities such as settlement patterns, hunting and logging (Barnes, 1991; Lahm, 1993, 1994). While villagers were formerly semi-nomadic, they now live in permanent communities along roads and major waterways, leaving extensive areas of uninhabited terrain and secondary regrowth in the forest interior.

As in other African countries (Bell, 1984; Osborn, 1992; Hoare & Mackie, 1993; Tchamba, 1995), elephant crop-raiding is a major problem in Gabon. Requests for government action to control elephant crop destruction have increased greatly within the past ten years despite the fact that villagers have dealt with crop-raiding animals for centuries.

To address this issue, a nationwide survey of village families was conducted from July 1993 to June 1994, under the direction of the African Elephant Conservation Co-ordinating Group (AECCG) in cooperation with the World Wide Fund for Nature, Gabon and the Ministry of Water and Forests. The primary objectives were to determine the extent and severity of crop-raiding by elephants and other animals and to assess the factors involved as a means to finding solutions. This paper presents the results of the survey.

METHODS

Survey team members included the author, two agents of the Ministry of Water and Forests and a villager who served as project assistant. Data were collected by means of a questionnaire pertaining to sources of income, agricultural practices, problems with crop destruction by animals and traditional methods of deterrence.

Villages were selected by stratified random sampling on road sections and populated waterways in each of the nine provinces of Gabon. Analysis of data from an initial pilot study of 38 villages in one province showed the optimum sample size for all other provinces to be between 15 and 20 villages. Ten to 30 families were interviewed in each village, depending on the size of the community and the availability of residents. In total, 2,926 families were interviewed in 218 villages throughout the country.

Families were asked to place crop-raiding animals into two categories: 1) most destructive (severe); 2) less destructive (minor). Where crop damage by elephants or other large mammals (buffalo, gorilla, bush pigs) was reported on a family's plantation(s), an investigator briefly assessed the damage using specific guidelines. These included notation of the crop(s) damaged, age of plantation, date and season of raiding, animal species responsible, distance of plantation from the village and proportion of crop(s) damaged.

STUDY AREA

Socio-economy

Gabon has a relatively small human population compared to many other African countries - about one million people - and an average density of 3.8 persons! km^2. About 60% of the people live in urban areas (data from Ministry of Planning, 1993). The major sources of revenue are oil, manganese, uranium and timber. Since the decrease in the price of oil in 1985 and the devaluation of the CFA franc in 1994, urban unemployment, commercial logging, and the economic dependency of villagers on the sale of crops and bush meat have increased dramatically (Tutin, 1992; Lahm, 1993).

Flora and fauna

The forests of Gabon are part of the Guineo-Congolian phytogeographic region which stretches from Guinea to eastern Zaire (White, 1983). About 15% of the country

is comprised of swamp, mangroves, steppe and savanna. At least 75% to 80% is forested (Caballe, 1983).

More than 130 species of mammals have been identified throughout Gabon, including 19 species of primates, 16 species of artiodactyls and at least 30 species of bats (Emmons et *al.*, 1983).

Regional agricultural practices

The small-scale, subsistence-orientated farming strategies are adapted for the local climate and topography. The major crops are bitter and sweet manioc, bananas, peanuts, maize and taro. Farmers practise rotational shifting cultivation. Crops are harvested for a few years from the same plantation, which is then left fallow for several more years.

In savanna areas of south-eastern, south-western and coastal Gabon, where the climate is characterised by one long, pronounced dry season, crops are planted once per year. Fields are cleared and planted twice per year in continuously forested areas elsewhere in the country (with equatorial and transitional climates), where there are two shorter, less well-defined, dry seasons.

Plantations are located as close to villages as possible, but the agricultural system demands much terrain. The distance of the crops from the villages depends on the local habitat and population size and may range from a few hundred metres to several kilometres or more. Most Gabonese farmers cultivate on the edge of the forest. Family members often plant in "blocks" of three or four contiguous fields, but the crops of an entire community are scattered over a wide area around the village. This, plus the fact that food is continuously harvested, increases the risk of year-long animal depredations.

Problem animal control policy

Elephant hunting was banned in Gabon in 1981. In cases of excessive crop destruction, the government may authorise control shooting, namely "battue administrative". The complainant contacts the local provincial office of the Ministry of Water and Forests. After inspection of the damage, a report is submitted to the provincial governor who should decide within eight days whether to authorise control shooting. Once given, the authorisation is valid for one month during which a maximum of two elephants, preferably males, may be shot by a designated hunter within five kilometres of the village. The tusks remain government property and the meat is given to the hunter and villagers. In reality, the decision may be delayed for weeks or months and/or authorised control shootings are seldom implemented because hunters are not paid and high-powered firearms cannot be found. Villagers usually bear the loss or resort to their own methods.

RESULTS

Village economy

Crops destroyed by animals represent a loss of food as well as income for villagers. Between 53% and 85% of the 2,926 families considered the sale of agricultural products to be a major source of income, depending on access to clients and local markets, especially large coastal cities. Most villagers sell some surplus crops. The sale of cane, palm and maize wines are important sources of revenue in three provinces in the interior of the country.

Crop-raiding species

Villagers named a total of 34 species of crop-raiding animals which included reptiles, birds and mammals, as listed in Table l. Three species were mentioned frequently as the most destructive and/or persistently present in plantations. In descending order of importance these were: the cane rat, the elephant and the brush-tailed porcupine.

Of the ten species of primates cited, only the mandrill, the talapoin and the white-collared mangabey each had greater than 1% representation of the total number of complaints. The forest buffalo and the bush pig were the only ungulate species among the nine cited which inflicted measurable crop damage.

Apart from unidentifiable mice and rats, villagers named seven species of rodents as crop-raiders. These ranged in size from the 100-1 50g striped squirrels to the 3-5kg cane rat. Even where villagers had no problems with elephants, the cane rat was always present, along with a variety of other animals which together form a "guild" of crop-raiders capable of inflicting destruction on a large proportion of crops.

With the exception of one province, the cane rat had the highest median percentage of total complaints about severe crop-raiding throughout Gabon, surpassing the elephant, as seen in Table 2.

Table 1. List of crop-raiding species cited by villagers in Gabon.

Common name	Scientific name
Reptiles	
Black burrowing snake	*species unknown*
Nile monitor lizard	*Varanus niloticus*
Birds	
Francolin	*Fracolinus squamatus*
Green fruit pigeon	*Treron australis*
Weaver	*Ploceus cucullatus*
Mammals	
Rodents	
Brush-tailed porcupine	*Atherurus afncanus*
Cane rat	*Tryonomys swinderianus*
Emin's rat	*Cricetomys emini*
Four-striped squirrels	*Funisciurus isabella, F lemnicatus*
Palm squirrel	*Epixerus ebii*
Stanger's squirrel	*Protoxerus stangeri*
Pangolins	
White-bellied pangolin	*Manis tricuspis*
Primates	
Black colobus	*Colobus satanas*
Gray-cheeked mangabey	*Cercocebus albigena*
White-collared mangabey	*Cercocebus torquatus*
Mandrill	*Mandrillus sprinx*
Moustached guenon	*Cercopithecus cephus*
Sun-tailed guenon	*Cercopithecus solatus*
Greater white-nosed guenon	*Cercopithecus nictitans*
Talapoin	*Miopithecus talapoin*
Chimpanzee	*Pan t. troglodytes*
Gorilla	*Gorilla g. gorilla*
Artiodactyls	
Bates's pygmy antelope	*Neotragus batesi*
Bay duiker	*Cephalophus dorsalis*
Blue duiker	*Cephalophus monticola*
Yellow-backed duiker	*Cephalophus sylvicultor*
Bushbuck	*Tragelaphus scriptus*
Sitatunga	*Tragelaphus spekei*
Chevrotain	*Hyemoschus aquaticus*
Forest buffalo	*Syncerus caffernanus*
Bush pig	*Potamochoerus porcus*
Hippopotamus	*Hippopotamus amphibius*
Proboscideans	
Forest elephant	*laxodonta africana cyclotis*

Table 2 Medians ofpercentages of total complaints for the cane rat andthe elephant in the nine pro vinces of Gabon.

Province	Cane rat		Elephant	
	%	Range	%	Range
Estuaire	78	49-89	11	0-27
Haut-Ogooue	58	37-72	6	0-13
Moyen-Ogooue	28	9-70	25	6-59
Ngounie	59	17-95	12	0-83
Nyanga	37	11-78	17	0-64
Ogooue-Ivindo	54	21-69	28	4-45
Ogooue-Lolo	68	43-79	15	0-45
Ogooue-Maritime	17	0-36	59	14-65
Woleu-Ntem	86	43-100	13	0-50

Distribution of severe elephant destruction

Elephant crop-raiding occurred in all provinces. However, the cane rat accounted for more than *50%* of total complaints about severe destruction of crops in six of the nine provinces (Table 2). This is because elephant crop-raiding varied greatly among and within provinces and appears to be both a seasonal and localised problem.

When registering complaints, villagers were asked to differentiate between severe and minor elephant damage. Severe damage was defined as frequent raids by elephants and/or a large proportion of crops destroyed during raids. Minor damage meant insignificant loss of crops. The map shows the three provinces, Ogooue-Maritime, Moyen-Ogooue and Ogooue-Ivindo, from which complaints about severe elephant crop destruction were most frequent. Those provinces with the least complaints were Estuaire and Woleu-Ntem in the northwest and Haut-Ogooue in the southeast, while the remaining provinces had scattered complaints about elephants on some road sections and none on others.

Crops eaten by elephants

Elephants eat a wide variety of crops including bananas, manioc, yams, sweet potatoes, pineapples and occasionally sugar cane. They appear to select banana plants of intermediate growth stage, breaking the stems to eat the inner core and young leaves. Of 79 crop-raiding evaluations in which maize stalks were destroyed by elephants, the majority (71%) of cases involved stalks which were trampled rather than eaten.

Elephants also seem to uproot and trample more bitter manioc than they actually eat, but they consumed most tubers of uprooted sweet manioc plants. They chewed sugar cane stalks and spat out the pulp.

Analysis of crop damage

We investigated a total of 132 cases of animal crop-raiding. Of these, 106 (80%) involved elephants only, 11% were attributed to elephants combined with other species such as pigs and gorillas, 4% were due to cane rats and 2% involved mandrills. The gorilla, bush pig and buffalo each had 1% representation of assessed crop-raiding incidents.

From evaluations of crop damage and conversations with villagers, it appears that bananas are the primary attraction for elephants. Bananas are usually planted on the plantation/forest edge where humus is present. This makes them more susceptible because elephants can easily feed and quickly return to the forest cover. Bananas were the most heavily damaged crop in the majority of investigated cases. We recorded damaged banana stems in 125 of 132 crop damage assessments, as shown in Table 3. From 81% to 100% of banana plants were destroyed in 54% of these incidents compared to 30% and 29% of cases of destruction of manioc plants and other crops, respectively, in the same percentage category level.

The extent of crop destruction varied. There were narrow trails of trampled crops where elephants passed through plantations into forest, providing evidence for limited foraging along the plantation/forest edge. There was also extensive feeding, uprooting and trampling by small groups of two to four animals. Elephants appeared to target banana stems first, then searched for other foods in an exploratory manner.

It was not always possible to estimate the number of animals involved. One elephant was implicated in 36 (63%) of 57 incidents and two or three elephants raided in 17(30%) of these cases. Most crop-raiding elephants remained within one or two “blocks” of plantations. In one well documented case, elephants foraged three times in the same three-hectare block of adjacent plantations within seven months, but did not move into other planted areas elsewhere near the village.

Figure. Provincial map of Gabon showing the three provinces most affected by elephant crop-raiding. Table 3. Percentage damage to plant foods from a total of 132 elephant crop-raiding incidents.

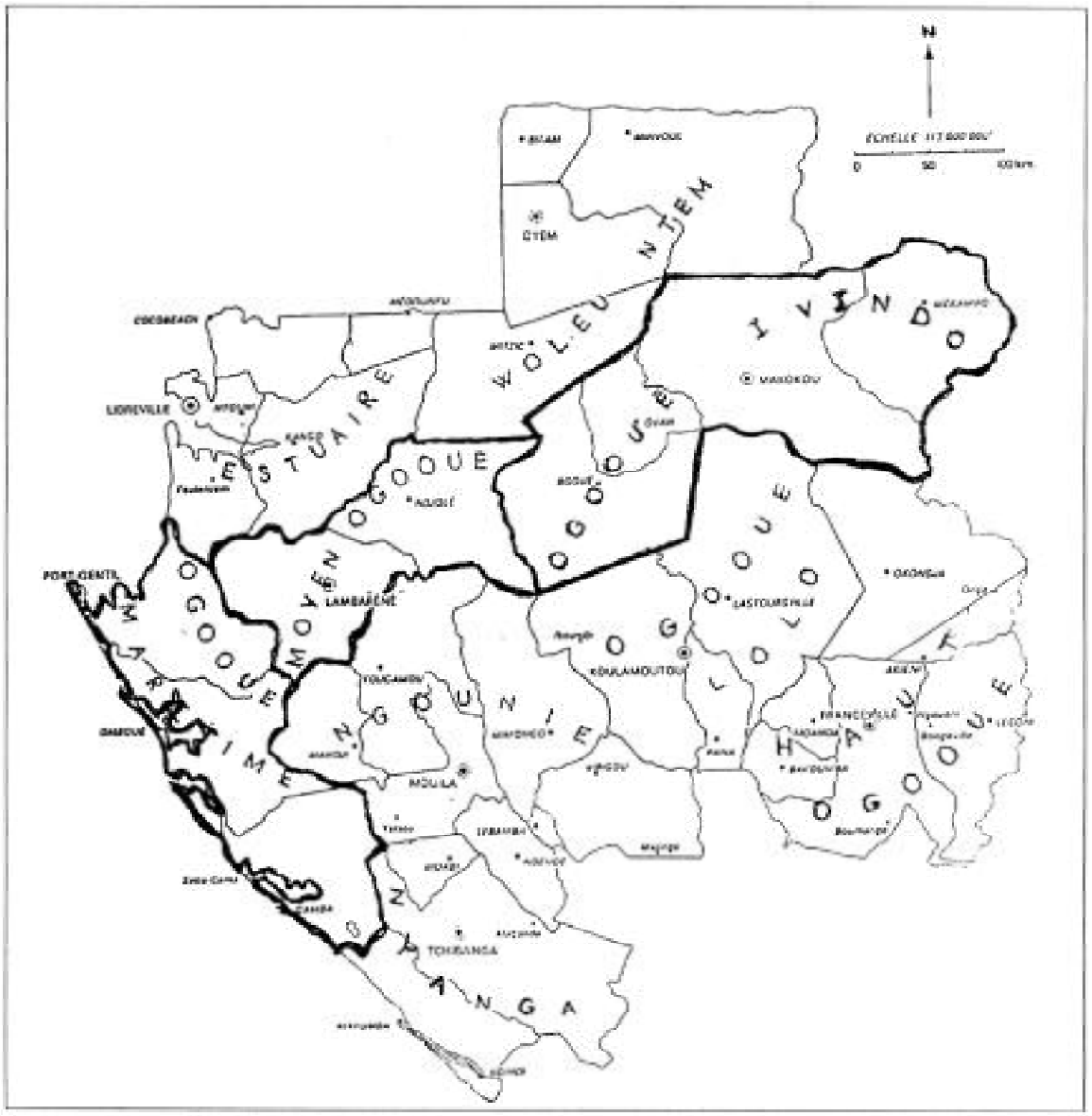

Figure. Provincial map of Gabon showing the three provinces most affected by elephant crop-raiding.

Table 3. Percentage damage to plant foods from a total of 132 elephant crop-raiding incidents.

crop	No. Cases	Percentage damage 0-20		21-40		41-60		61-80		81-100	
		No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Manioc	122	18	(15)	38	(31)	18	(15)	11	(09)	37	(30)
Bananas	125	19	(15)	07	(06)	19	(15)	12	(10)	68	(54)
Other*	123	26	(21)	05	(05)	03	(02)	53	(43)	36	(29)

**taro, maize, sweet potatoes, yams, concombre gourds, pineapples, sugar cane*

Seasonality of crop-raiding

Elephant presence in plantations in Gabon appears to be influenced by seasonal change. Villagers in forested regions said that most elephants migrate towards swamps and rivers during the long, dry season (July, August) and disperse into the forest towards villages when the rains begin again in September/ October. Of 229 registered incidents of elephant crop-raiding near forest villages, the majority occurred during a wet season (Table 4). Few people said that elephant damage did not occur during a defined season. It appears that elephants generally do not feed in plantations during January and February, which is the short, dry season, when fruits and herbs are abundant in the forest. Thus, there are fewer cases of elephant crop-raiding in forest villages during dry conditions.

The phenomenon is less clear for savanna areas owing to regional variations. In south-eastern and southwestern Gabon, most registered crop-raiding incidents in savanna villages occurred during the long, dry season (Table 4). However, on coastal savannas, which are largely in a transitional climatic zone between equatorial and pure tropical climates, people said that elephant depredations occur mainly during the wet season.

Table 4. Number of registered elephant crop - raiding incidents in relation to habitat type and season.

Habitat type	No.of cases	SEASONS Dry No.	(%)	Wet No.	(%)	All year No.	(%)
Savanna	85	59	(69)	23	(27)	03	(04)
Forest	229	55	(24)	174	(71)	11	(05)

Traditional deterrence measures

Survey results indicate that many villagers make little effort to protect their plantations. Of the 2,926 families interviewed, 1,053 (36%) said that they do nothing to deter crop-raiding. Thirty-eight percent said that they set traps around plantations; 23% erect barriers of palm fronds, wooden slats or old, tin roofing material; and 11% camp near their crops. Four percent of respondents hunt near their plantations. Most of the traps observed were set for animals ranging in size from large rodents to duikers. We saw only two traps made for elephants.

Methods used specifically to deter elephants included lighting fires or lamps at plantation perimeters (5% of 2,926 families), beating on metallic surfaces (4%), hanging cables or vines with attached bottles and tin cans (3%), and making scarecrows (3%). In some cases of persistent elephant crop-raiding, people eventually abandoned the location in recognition of the elephants' attraction to a local resource nearby, such as a swamp or fruiting trees.

DISCUSSION

Government policy

The largely ineffective use of control shooting to curtail elephant crop-raiding in Africa has served mainly to appease villagers (Bell, 1984; Hoare & Mackie, 1993). Compensation schemes have had little success in Kenya and Cameroon (Ngure, 1995; Tchamba, 1995).

Theoretically, control shooting of elephants could reduce crop-raiding by conditioning group members when more than one elephant is involved. However, the centralised decision-making process is burdensome and usually is delayed for weeks or months during which the raiding elephant(s) may have left the vicinity (Lahm, 1994; Kangwana, 1995).

In Gabon, control shooting usually occurs long after the event. Because the law requires that an elephant be shot within five kilometres of the affected village, delayed authorisations may result in the death of a non-raiding animal while the original culprit(s) may return. More often, no control shooting occurs because neither the hunter nor the appropriate firearm are available. Despite this, all families interviewed in the survey who were affected by elephant crop-raiding preferred shooting elephants to compensation because they feared continuation of raids.

Obviously, a change in policy is needed not only to ameliorate the problem but to improve the strained relations between the villagers and the wildlife agents. One suggestion is to create associations of village hunters. The hunters would be paid for control shooting and would develop a reporting system within each district, similar to that used in Zimbabwe (Hoare, 1995). This would require central government policy shifts towards local management and would be open to abusive practices, but it would ensure rapid response to severe crop damage as well as greatly improving public relations and incorporating villagers in local wildlife management.

Policies about crop-raiding elephants should be part of a national management plan for Gabon's abundant and significant elephant population. Although the elephant is an officially protected animal, and there are laws which regulate hunting and ownership of firearms, no management plan exists for the elephant or for any other species of animal in the country.

Inter- and intra-provincial differences

There was much variation in elephant damage within and among provinces, indicating that elephant crop-raiding problems might best be dealt with on provincial and local levels rather than as part of a generalised national plan. The latter would shift the decision-making process to ministry headquarters in the capital, thus increasing delays. National or provincial meetings could be held to identify and discuss local areas of persistent elephant crop-raiding. For example, in the southwest, large areas of mature, forested elephant habitat, are cleared annually for commercial banana plantations, creating a prime attraction for elephants. This can only lead to continued conflict.

The attraction of elephants to particular habitats may also influence the frequency and occurrence of crop-raiding. The three most affected provinces are characterised by large expanses of water and swampy terrain. While Barnes (1991) demonstrated that elephants show preference for secondary regrowth, Lahm (1993) and Ekobo (1995) found strong associations between elephants and "wet" habitats (swamp, marsh and seasonally inundated forest).

The rural exodus of villagers also contributes to crop-raiding. As people increasingly move to urban areas, there are fewer farmers and hunters on the land, which can then be re-occupied by elephants and other animals. In the coastal province of Ogooue-Maritime, which registered the highest number of complaints about severe elephant crop-raiding in the survey, rural exodus appeared to be accelerating. This is undoubtedly due to the proximity of Port Gentil and Libreville, the largest urban centres, and to the base of Shell Oil. Many villages in this province consisted of tiny hamlets of four or five families, often comprised mainly of older people.

Protection of plantations

Rural exodus also leads to lack of crop protection, which is considered to be work for men. Many young men go from their villages in search of work, leaving women, children and the elderly behind. Women, even at an advanced age, continue to plant and harvest crops, but older men are frequently unable or unwilling to protect fields by setting traps, erecting barriers, etc.

Changes in village organisation and institutions have resulted in less cohesive, fragmented societies. Traditional communal practices which united village residents, such as net hunting, planting and cooperative crop protection have been largely abandoned in favour of individually-owned firearms and scattered agricultural plots (Lahm, 1993). Many young village men and boys encountered during the survey expressed disinterest in agriculture, the forest milieu or traditional male activities.

Because elephant crop-raiding is widespread and the agricultural system is no longer strategically organised for defense against crop-raiding animals, plantations cannot be protected efficiently. It is clear that electric fencing is not a viable solution to the problem of elephant crop-raiding for the majority of the rural Gabonese population. Using the criteria from Hoare (1995) for electric fencing schemes employed in Zimbabwe, it would cost at least $21,000 to provide sufficient protection of crops for one small village of 125 people whose crops are dispersed over an area of 21km^2 (Lahm, 1994).

Changes in land-use planning

Unlike in Kenya, where 119 people were killed by elephants between 1990-1993 (Kiiru, 1995), elephant attacks on humans are rare in Gabon. The low human population density, clumped distribution of settlements along roads, and general lack of active defense of plantations leave fewer opportunities for elephant] human contact but more opportunities for elephant crop-raiding. Because plantations are widely dispersed, often unprotected, frequently far from villages and located on forest edges, they are highly vulnerable to crop-raiding by a variety of animals.

In conjunction with the revision of the elephant control shooting policy, current agricultural strategies could be improved with the objectives of decreasing crop-raiding, involving the participation of village men, and improving local working conditions.

Lack of time prevented evaluation of success rates of various indigenous methods of controlling crop-raiding elephants and other animals. This evaluation could be incorporated into experiments with collective planting, different fallow schemes and organised crop protection in selected villages.

Crop-raiding by cane rats

The number of overall complaints about cane rats far surpassed those of any other animal species, including the elephant. Is the latter the most economically important crop-raider? By reason of its large body size, an elephant is capable of inflicting heavy damage. However, the fact that elephant crop-raiding appears to be more of a localised and seasonal problem suggests that continuous, low-level consumption of food crops throughout Gabon by a huge, uncontrolled cane rat population may be more destructive in the long term. Therefore, the problem of crop-raiding by both species needs to be addressed further.

CONCLUSIONS AND RECOMMENDATIONS

The phenomenon of crop-raiding in Gabon is very complex and the study generated more questions than it answered. Recommendations include the improvement of farming practices, a thorough review of the elephant control shooting policy and the creation of an elephant management plan. The legalisation of elephant hunting for citizens is not proposed as a solution to the problem because elephant hunting is already widespread and largely uncontrolled in the country (Lahm, 1993, 1994; Dublin *et al.*, 1995).

Other recommendations include the improvement of the professional capacity and management capability within the Ministry of Water and Forests by training agents in the classroom and on-site, in communication skills and general public relations and providing them with standardised forms for evaluating crop damage and cases of control shooting. Finally, it is recommeiided that a project be developed which focusses on the control of cane rat populations.

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Photo credit: Chris Thouless

An elephant crossing an electric fence in Laikipia District, Kenya.