# Primate Crop Raiding in Uganda: actual and perceived risks around Budongo Forest Reserve

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The following pages have been redacted at the request of the University;

Appendix 1 map

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# ABSTRACT

Crop damage by wildlife is a significant threat to global conservation and human development. This interdisciplinary study compared the actual and perceived risk of primate crop raiding around Budongo Forest Reserve, northwest Uganda during 2004/2005.

Weekly farm monitoring established that at least seven wild species damage crops, and primates (primarily baboons) are responsible for forty percent of all raids. The creation of risk maps using GIS technology and logistic regression revealed that those cultivating maize close to the forest edge are particularly vulnerable to loss. An elevated level of human presence was found to significantly reduce raids by wild species although it is not considered effective due to the high social cost. Overall the majority of farmers experience little damage by wildlife and many other factors limit agricultural production e.g. insects, weather and domestic livestock; goats raid more frequently than any other animal and their pruning of maize was proven to significantly reduce yield.

Despite the low risk of actual loss, semi-structured interviews, focus groups and participant observation revealed that crop raiding by wild species is believed to be the most significant limitation to livelihoods in this area. Damage intensity, fluctuations in social condition and restrictions on traditional crop protection methods all inflate perceptions of risk. Crop damage by wildlife also symbolizes control by external forces; the forest is believed to be 'owned' by the same organizations that impose conservation legislation and restrict access to resources. Raiding species, and primates in particular, are judged alongside human moral values and local people are more tolerant of animals they believe they can control or that have associated benefits i.e. domestic and game species.

This thesis emphasises the need to both reduce damage to acceptable levels and increase tolerance toward wild species at this site. Mitigation strategies are suggested that build upon traditional techniques, provide an economic incentive for conserving wildlife and assist farmers to manage the conflict. Ultimately, however, the success of any initiative will depend on the participation of local people.

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## ACRONYMS

| | |
|---|---|
| AIDS | Acquired Immune Deficiency Syndrome |
| ASA | Association of Social Anthropologists |
| BFP | Budongo Forest Project |
| BFR | Budongo Forest Reserve |
| BUCODO | Budongo Forest Community Development Organisation |
| DEFRA (UK) | Department for Environment, Food and Rural Affairs |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| HWC | Human-Wildlife Conflict |
| INIBAP | International Network for the Improvement of Banana and Plantain |
| IPM | Integrated Pest Management |
| IUCN | World Conservation Union |
| JGI | Jane Goodall Institute |
| KSWL | Kinyara Sugar Works Ltd |
| LRA | Lords Resistance Army |
| NFA | National Forestry Authority |
| NGO | Non-Governmental Organisation |
| NRM | National Resistance Movement |
| SOCP | Sumatran Orangutan Conservation Programme |
| SA | Spatial Autocorrelation |
| SPSS | Statistical Package for the Social Sciences |
| SSI | Semi-Structured Interview |
| UBOS | Uganda Bureau of Statistics |
| UMOH | Ugandan Ministry of Health |
| UWA | Uganda Wildlife Authority |
| WCS | Wildlife Conservation Society |
| WHO | World Health Organisation |

# 1. INTRODUCTION

This study is a comparison of the actual and perceived risk of crop raiding[1] by primates around Budongo Forest Reserve (BFR), northwest Uganda. Despite a growing body of literature examining human-wildlife conflict (e.g. Knight, 2000b, Paterson and Wallis, 2005, Woodroffe *et al.*, 2005), the majority of research focuses on either actual loss or perceptions of local people toward damage[2]. This study, in contrast, is interdisciplinary and examines both environmental and social factors at the same time. A holistic approach to human-wildlife conflict is essential. This will enable the development of mitigation strategies that are not only effective but acceptable to local people and thus sustainable in the long term.

Few studies have examined the impact of vertebrate pests upon agricultural systems and they are seldom included in Integrated Pest Management (IPM) strategies (Van Vuren and Smallwood, 1996, Hill, 1997). This study will focus on crop damage by primates as little is known of their impact upon subsistence agriculture despite considerable conflict throughout Africa and Asia (e.g. Strum, 1994, Knight, 1999, Madden, 1999, Hill, 2000, Sprague, 2002, Priston, 2005). In addition, primates are often the focus of conservation legislation which can exacerbate, and even generate human-wildlife conflict (Knight, 2000a, Hill, 2005), by restricting the use of traditional crop protection methods e.g. trapping and communal hunts (Conover and Decker, 1991, Hill, 1991, Naughton-Treves, 1996, Ezealor and Giles, 1997, Osborn and Hill, 2005). Farmers also come under the scrutiny of external organizations (Knight, 1999, Hill, 2005) and can feel frustrated and resentful that their situation is not recognized by wildlife authorities and conservation agencies (e.g. Conover and Decker, 1991, Jhala, 1993, Wild and Mutebi, 1997, Hill, 2000, Biryahwaho, 2002, Plumptre, 2002, Wheatley *et al.*, 2002). Thus the utilization of food crops by non-human primates can

[1] The terminology of human-wildlife conflict carries negative connotations and implies that animals are aware of the consequences of their utilisation of human food crops. This is, of course, not true. However, for readability and to align with previous research, phrases such as 'crop raiding' and 'problem animal' will be used throughout this thesis.
[2] Notable exceptions include Naughton-Treves (1996), Hill (1997), Gillingham and Lee (2003) and Priston (2005)

cause significant problems for both farmers and environmentalists. With a current move toward community-based conservation as an effective method of protecting biodiversity (IIED, 1994, Newmark *et al.*, 1994, Knight, 1999, Naughton-Treves, 2001) this issue must be addressed. Chapter 2 will provide a general background to vertebrate crop damage, its significance for global conservation and the specific problems faced by primates and farmers in villages south of BFR.

BFR is the site of increasing human-wildlife conflict and complaints regarding crop damage are increasing (Byarugaba, Vermin Control Officer, 2006, *pers comm*, Tweheyo *et al.*, 2005). In addition, endangered primates (i.e. chimpanzees) have been killed or maimed by non-specific crop protection strategies[3] used to protect fields from 'vermin' species (Waller and Reynolds, 2001, Reynolds, 2005)[4]. Research is urgently needed to understand the actual impact of primates on subsistence agriculture around BFR and this study was established to examine these issues.

Previous research on the use of human foods by primates has tended to focus upon quantifying crop loss and identifying relationships with external events, including forest fruit availability, rainfall and distance from the forest edge (e.g. Strum, 1994, Hill, 1997, Naughton-Treves *et al.*, 1998). These studies highlight the need for a thorough examination of the crop raiding landscape to identify factors that influence the likelihood of damage. Geographic Information Systems (GIS) technology is a flexible and systematic method of integrating data through a spatial reference system (Michelmore, 1994, Foote and Lynch, 1995, Chou, 1997, Durand *et al.*, 2004). As such, it can be used in human-wildlife conflict mitigation to identify areas at high risk from increased competition and negative interaction between people and animals (see Fox *et al.*, 1996, Le Lay *et al.*, 2001, Sitati *et al.*, 2003, Malo *et al.*, 2004). This

[3] Snares, leg-hold traps ('man traps') and poison may be intended for problem animals but due to their indiscriminate nature, can kill or maim other wildlife

[4] Bush pig, baboons and vervet monkeys are all classed as vermin in Uganda policy documents. Although vermin species are allowed to be killed if causing threat to life or property, non-selective vermin control methods are illegal in this area (Masindi District Local Government Environmental Protection Unit Bylaw Section 26(5) of Ordinance Supplement No.2 to the Uganda Gazette No 61, Volume XCV, 8 November 2002 and punishable by fines or imprisonment; these are, however, small and seldom enforced (Reynolds, 2005).

research develops a GIS to assimilate factors that impact upon crop damage around BFR and identify vulnerable areas at the farm level (Chapter 5). Although primarily concerned with loss by primates, it will examine crop damage by all large vertebrate species (including domestic animals) to fully evaluate their significance relative to other risks. This study uses GIS to identify and compare areas at risk from crop damage by wild, domestic and primate species at one site of human-wildlife conflict. This is important in order to develop effective management in areas with high levels of fragmented forest and agricultural development (Chapman and Peres, 2001).

In order to fully understand human-wildlife conflict scenarios, it is not only important to examine the complex relationship between wildlife and domesticated crops but also the attitudes of local people and their definitions of problem animals. To date, little research has focused on the farmer's perspective regarding primate damage to food crops or attitudes to primates generally (King and Lee, 1987, Hill, 2002, Lee and Priston, 2005). Chapter 6 will examine this issue but it will not focus on one raiding species or group (i.e. primates) but all large vertebrates causing damage at this site. This is essential to fully understand the key factors influencing attitudes and thus acceptance of future mitigation.

It is clear that specific management strategies need to be developed to both assist vulnerable, resource-poor farmers to cope with potential agricultural loss and protect endangered wildlife. However, it is first important to identify the crop protection techniques in use at conflict sites and evaluate if they are effective at reducing crop damage. Mitigation around BFR will be more successful if it is based upon methods that are already accepted by local people. Many studies record which strategies are used but seldom do researchers address the reasons for the utilization of specific techniques. Chapter 7 will examine both of these important issues in order to contribute to current research on effective mitigation.

Chapter 8 will compare the actual and perceived risk of crop raiding at this site and discuss any fundamental differences in results. Although this study is not primarily concerned with conflict mitigation, the information will be used to suggest possible strategies that could alleviate tension at this site and increase tolerance toward protected species.

### 1.1 Study Aims

This study aims to identify the actual risk of crop damage by primates around BFR alongside perceptions of the problem. As other researchers have highlighted, it is very difficult to solve human-wildlife conflict but it is possible to "reduce risk by decreasing the vulnerability of the environment to the risk or the perception of the risk" (Le Lay *et al.*, 2001, p.452). Whilst this study is primarily concerned with damage by primate species, it is important to examine other environmental and social factors in order to fully engage with the human-wildlife conflict scenario.

### 1.2 Specific Aims

Chapter 2

- Outline the problem of human-wildlife conflict and primate crop raiding in a global context and its significance around BFR

Chapter 3

- Describe the methods used to measure actual and perceived risk of crop loss

Chapter 4

- Present demographic information for the research sample

Chapter 5

- Ascertain the actual level of crop damage experienced by farmers and how primates contribute to this loss.

- Identify any temporal, spatial or land use variables that may help to identify which farms are particularly vulnerable to crop damage.

Chapter 6

- Examine local people's perceptions of crop loss in comparison with other risks.
- Explore views toward specific raiding species, in particular primates.

Chapter 7

- Identify which crop protection strategies are being used for primates and other raiding animals and local people's perceptions toward them.

Chapter 8

- Explore the link between the actual and perceived risk of primate crop raiding and identify key factors that contribute to this relationship.
- Suggest considerations in the development of successful conflict mitigation that will reduce both the actual and perceived threat of crop raiding by primates and other large vertebrates

# 2. PUTTING THE CONFLICT IN CONTEXT

## 2.1 Human-Wildlife Conflict

Human-wildlife conflict (HWC) has the potential to occur wherever people and wildlife are in close proximity and thus competing for resources. It has happened for millennia in most areas of the globe and involves a diverse range of wild species (Knight, 2000a).

HWC can include a direct threat to human life; for example, crocodiles, large felids and *Hymenoptera* (bees/ hornets/ wasps) can kill and injure people (e.g. Beier, 1991, Scott and Scott, 1994, Goyal, 2001, Langley, 2005). In addition, more than 1 million people worldwide are killed every year by the *Anopheles* mosquito as a vector for the malaria parasite (WHO, 2006). HWC can also impact upon livelihoods; carnivores predate domestic animals (e.g. Rao *et al.*, 2002, Naughton-Treves *et al.*, 2003, Jackson and Wangchuk, 2004, Patterson *et al.*, 2004, Bradley *et al.*, 2005, Gadd, 2005, Kolowski and Holekamp, 2006) and wild herbivores compete with livestock for grazing land (O'Meilia *et al.*, 1982, Viggers and Hearn, 2005). Wild species can also spread disease to domestic animals, for example, badgers (*Meles meles*) are believed to transmit bovine tuberculosis to cattle (Donnelly *et al.*, 2003)[5]. However, HWC is not only a threat to people; animals can be harassed, relocated or killed (e.g. Barnes and Hill, 1992, Knight, 1999, Madden, 1999, Imam *et al.*, 2002, Sitati *et al.*, 2003).

Whilst HWC is not new, an increase in human populations and subsequent destruction of natural habitat and loss of prey species is forcing wildlife to live within human-dominated landscapes (Mascarenhas, 1971, Blair *et al.*, 1979, Southwick *et al.*, 1983, Brooks *et al.*, 1989, Starin, 1989, Else, 1991, Naughton-Treves, 2001, Fall and Jackson, 2002). This interaction can be detrimental to both people *and* wildlife. For example, road-traffic accidents and wildlife strikes on civil aircraft cause injury/ death to both humans and wild animals in addition to extensive economic loss (Van Gelder, 1973,

[5] This relationship is still not well understood. The study by Donnelly et al (2003) demonstrated that not only did lethal control fail to manage the disease but reactive culling of badgers was actually associated with a rise in the number of cattle with bovine TB.

Malo *et al.*, 2004, Seiler, 2005, Cleary *et al.*, 2006). The global rise in leisure and tourism activities also increases the potential for HWC as people visit and utilize wild spaces. For example, manatees are injured by motorboats in Florida (Aipanjiguly *et al.*, 2003), bears attack visitors to Canadian National Parks (CTV, 2005) and tourists are frequently threatened by primates in Africa and Asia (e.g. Eley and Else, 1984, Brennan *et al.*, 1985, Lee *et al.*, 1986, Zhao, 2005).

Understandably, HWC can create a negative attitude towards wildlife and reduce support for conservation (e.g. Parry and Campbell, 1992, Heinen, 1993, Newmark *et al.*, 1994, Nepal and Weber, 1995, Naughton-Treves, 1996, De Boer and Baquete, 1998, Gillingham and Lee, 1999, Madhusudan, 2003, Gadd, 2005, Okello, 2005, Tweheyo *et al.*, 2005). In addition, animals may be at risk if local people resist environmental initiatives and engage in potential 'retributive' action, e.g. trespassing, poaching, trapping (Little, 1994, Wild and Mutebi, 1997, Knight, 2000a, Rao *et al.*, 2002, Andama and McNeilage, 2003, Weladji and Tchamba, 2003, Jackson and Wangchuk, 2004). Therefore, HWC has been recognized as one of the most significant threats to conservation (Morningside Declaration, 1998) and IUCN recently supported an international workshop to address this issue (World Parks Congress, 2003). One of the most common, ancient and global examples of HWC is crop raiding (Naughton-Treves, 1996, Hill, 1997, Sitati *et al.*, 2003, Osborn and Hill, 2005) whereby a range of animals, insects and birds utilize cultivated crops as food resources.

## 2.2 Crop Damage by Wildlife

Crop damage by wildlife is not a new problem. However, human population expansion, migration, the intensification of agriculture and the development of large scale commercial farming operations is escalating the conflict, and animal habitat worldwide is being increasingly converted to farmland[6] (e.g. Poirier, 1971, Blair *et al.*,

[6] It should be noted that whilst population growth drives an increase in the amount of land put under cultivation, in developing countries the amount per capita has fallen (Dixon *et al.*, 2001).

1979, Southwick *et al.*, 1983, Biquand *et al.*, 1994, Hill, 1997, Tattersall, 1998, Imam *et al.*, 2002, Sitati *et al.*, 2003).

A range of wildlife can damage crops. For example, birds, insects and rodents are responsible for significant losses to fruit and grains (e.g. Mascarenhas, 1971, Conover and Decker, 1991, Chitere and Omolo, 1993, Adesina *et al.*, 1994, Tourenq *et al.*, 2001, Somers and Morris, 2002, Andama and McNeilage, 2003, Dhillon *et al.*, 2005). Mammals can be a particular problem (Table 2.1) and many orders damage agricultural crops either by foraging or destroying the plant through digging or trampling (*Primates* are not included as they will be discussed in more depth in section 2.3, however it should be noted that many species consume human foods[7]). This is not an exhaustive list, rather it is used to demonstrate the variety of mammals involved and the disparate locations where crop damage is known to occur. It should be noted that whilst 12 orders are not found to damage agricultural crops or plantations, they can come into conflict with humans in other ways; for example, the long nosed bandicoot (*Perameles nasuta - Peramelemorphia*) damages suburban lawns (NSW National Parks & Wildlife Service 2000) and opposums (*Didelphis virginiana - Didelphimorphia*) raid rubbish bins in urban areas (Jackson, 1994).

Like many examples of HWC, crop raiding has significant ramifications for both people and wildlife. Crop damage can result in substantial economic loss. For example, it has been estimated that up to 25,000 acres of oil palm plantation were destroyed by elephants in Malaysia in the late 1970's and approximately £50 million worth of cereal crops are lost to the rabbit every year in the UK (Blair *et al.*, 1979, DEFRA, 2004). For mechanized and intensive agricultural systems this is a considerable financial deficit. However, subsistence farmers can lose not only potential income but also labour and valuable foodstuffs during periods of food insecurity.

[7] In this study, 'human foods' describes crops and fruits grown specifically for human consumption e.g. in plantations or agricultural areas, including kitchen gardens.

**Table 2.1 Examples of Mammalia responsible for crop damage globally (excluding *Primates*)***

| Species | Latin Name | Location | References |
|---|---|---|---|
| ***Afrosoricida*** | | | |
| Rice tenrec | *Oryzorictes hova* | Madagascar | (Goodman, 2003) |
| ***Artiodactyla*** | | | |
| Hippopotomus | *Hippopotamus amphibious* | Mozambique, Gambia | (Clarke, 1953, De Boer and Baquete, 1998) |
| Wild Boar | *Sus sp.* | Europe, Pakistan, Indonesia, India, Malaysia | (Blair *et al.*, 1979, Brooks *et al.*, 1989, Salafsky, 1993, Rao *et al.*, 2002, Schley and Roper, 2003, Geisser and Reyer, 2004) |
| Bush Pig | *Potamochoerus sp.* | Uganda, Mozambique, Gambia | (Clarke, 1953, Hill, 1997, De Boer and Baquete, 1998, Biryahwaho, 2002, Andama and McNeilage, 2003, Kagoro-Rugunda, 2004, Tweheyo *et al.*, 2005) |
| Deer | *Odocoileus, Moscus & Cervus sp.* | Malaysia, US, Indonesia, India | (Brown *et al.*, 1978, Conover and Decker, 1991, Salafsky, 1993, Loker *et al.*, 1999, Drake and Grande, 2002, Rao *et al.*, 2002) |
| Duiker | *Cephalophus sp* | Uganda, Mozambique | (Hill, 1997, De Boer and Baquete, 1998) |
| African Buffalo | *Syncerus caffer* | Kenya, Uganda, Rwanda | (Biryahwaho, 2002, Plumptre, 2002, Gadd, 2005) |
| ***Carnivora*** | | | |
| Leopard Cat | *Felis bengalensis* | Indonesia | (Salafsky, 1993) |
| African Civet | *Civettictis civetta* | Uganda | (Hill, 1997, Andama and McNeilage, 2003) |
| Eurasian Badger | *Meles meles* | UK | (Poole *et al.*, 2002) |
| Racoon | *Procyon lotor* | US | (Conover, 1994, Drake and Grande, 2002) |
| Bear | *Ursus sp.* | US, Indonesia, India | (Salafsky, 1993, Conover, 1994, Peine, 2001, Drake and Grande, 2002, Rao *et al.*, 2002) |
| ***Chiroptera*** | | | |
| Fruit Bat | *Megachiroptera* | Maldives, Sahel | (Hunter, 1996, Ezealor and Giles, 1997) |
| ***Dermoptera*** | | | |
| Colugo | *Cynocephalus variegatus* | Southeast Asia | (Ellis, 1999) |
| ***Diprotodontia*** | | | |
| Kangaroo | *Macropus giganteus* | Australia | (Barnes and Hill, 1992) |
| Possum | *Trichosurus vulpecula* | New Zealand | (Coleman, 1993) |
| ***Hyracoidea*** | | | |
| Hyrax | *Dendrohyrax sp.* | Rwanda | (Plumptre, 2002) |

| | | | |
|---|---|---|---|
| ***Insectivora*** | | | |
| Mole | *Scalopus & Talpa sp.* | US, UK, Kenya | (Chitere and Omolo, 1993, Henderson, 1994, DEFRA, 2005) |
| ***Lagomorpha*** | | | |
| Rabbit | *Lepus & Oryctolagus sp.* | US, UK | (Conover, 1994, Drake and Grande, 2002, DEFRA, 2004) |
| Uganda grass-hare | *Poelagus marjorita* | Uganda | (Hill, 1997) |
| ***Perissodactyla*** | | | |
| Zebra | *Equus burchelli* | Kenya | (Gadd, 2005, Okello, 2005) |
| Brazilian Tapir | *Tapirus terrestris* | Peru | (Naughton-Treves *et al.*, 2003) |
| ***Proboscidea*** | | | |
| African Elephant | *Loxodonta africana* | Kenya, Malawi, Uganda, Mozambique, Cameroon | (Bhima, 1998, De Boer and Baquete, 1998, Biryahwaho, 2002, Sitati *et al.*, 2003, Weladji and Tchamba, 2003, Gadd, 2005) |
| Asian Elephant | *Elephas maximus* | Malaysia, India | (Blair *et al.*, 1979, Sukumar, 1990, Madhusudan, 2003) |
| ***Rodentia*** | | | |
| Mice & Rat | *Mus & Rattus* sp. | US, Indonesia, Maldives, Uganda, Cameroon | (Salafsky, 1993, Conover, 1994, Hunter, 1996, Hill, 1997, Drake and Grande, 2002, Andama and McNeilage, 2003) |
| Porcupine | *Hystrix sp* | Indonesia, Malaysia, Uganda, Kenya, Cameroon, India | (Blair *et al.*, 1979, Salafsky, 1993, Hill, 1997, Biryahwaho, 2002, Rao *et al.*, 2002, Andama and McNeilage, 2003, Kagoro-Rugunda, 2004, Gadd, 2005, Tweheyo *et al.*, 2005) |
| Squirrel | *Callosciurus & Xerus sp* | Indonesia, Uganda | (Salafsky, 1993, Hill, 1997) |
| Prairie Dog | *Cynomys sp.* | US | (Conover, 1994) |
| Capybara | *Hydrochaeris hydrochaeris* | Peru | (Naughton-Treves *et al.*, 2003) |
| Wood Chuck | *Marmota monax* | US | (Conover, 1994, Drake and Grande, 2002) |
| ***Tubulidentata*** | | | |
| Aardvark | *Orycteropus afer* | Africa | (Fox, 2006) |
| ***Xenartha*** | | | |
| Armadillo | *Daspys sp.* | US | (Hawthorne, 1994) |

* Mammalian orders not found to damage agricultural crops or fruit plantations – *Cetacea* (whale/dolphin/porpoise), *Dasyuromorphia* (dasyurids/ Tasmanian devil etc), *Didelphimorphia* (opossums), *Macroscelidea* (elephant shrew), *Microbiotheria* (monito del monte), *Monotremata* (platypus/ echidna), *Notoryctemorphia* (marsupial moles), *Paucituberculata* (shrew opposums), *Peramelemorphia* (bandicoots), *Pholidota* (pangolin), *Scandentia* (tree shrew) and *Sirenia* (manatee/dugong)

In extreme situations, crop damage by wildlife can cause people to abandon their farms and thus their main livelihood (Bell, 1984, Naughton-Treves, 1996, Biryahwaho, 2002, Madhusudan, 2003, Sitati *et al.*, 2003, Hill, 2004). This is highly significant in developing countries where a large proportion of the world's poorest people live in rural areas and are dependent on agriculture (Dixon *et al.*, 2001). In addition, biodiversity is often high and many raiding species are protected by international conservation legislation (e.g. Clarke, 1953, De Boer and Baquete, 1998, Madden, 1999, Sitati *et al.*, 2003).

Whilst crop damage by wildlife can clearly incur high costs at the agricultural interface, it is important to note that 'pest', 'problem animal' and 'risk' are socially constructed concepts (Slovic, 1997, Knight, 2000a). Therefore, damage may be exaggerated, misidentified or over-estimated (Mascarenhas, 1971, Bell, 1984, Putman, 1989, Salafsky, 1993, Biryahwaho, 2002). Views can also change temporally and spatially (Fitchen *et al.*, 1987, Coleman, 1993, Knight, 2000a) and it is possible for an animal to be both a problem to one person and a benefit to another (Naughton-Treves, 1996). For example, deer can be despised as a disease vector and cause of vehicle accidents but venerated as a hunting opportunity (Zinn *et al.*, 2000, Raik *et al.*, 2005). As Putman (1989) eloquently explains, "pestiness is in the eye of the beholder" (p.2). Clearly different groups will have different reasons for classifying an animal as a pest and it is important that these dynamics are understood in any conflict scenario in order for mitigation to be effective.

As this section highlights, crop raiding is a major source of human-wildlife conflict around the globe. Numerous species damage crops, however, this study will focus on crop raiding by primates. Their behavioural flexibility, sometimes intimidating behaviour and frequently protected status can cause considerable problems for both farmers and conservationists (Forthman-Quick, 1986, Else, 1991, Strum, 1994, Hill, 2000, Humle, 2003, Lee and Priston, 2005).

## 2.3 Primates as Crop Raiders

A wide range of primate species damage agricultural crops and farmers worldwide report them to be a significant problem (Table 2.2). There are very few taxa that do not utilize human foods, however, with their exclusively insectivorous diet (Rowe, 1996) it is unsurprising that tarsiers are not recorded causing crop damage. In addition, dwarf and mouse lemurs are rarely found in cultivated areas due to their restricted range and sensitivity to human disturbance (Wolfheim, 1983). Siamangs and gibbons are also unlikely to damage agricultural crops as they are predominately high canopy feeders, although some species reportedly do come to the ground to eat (Rowe, 1996).

Apart from these anomalies, many primates are able to successfully utilize human foods. This is a consequence of their feeding ecology; most species are omnivorous, eat similar foods to people and can thus respond opportunistically to novel items (e.g. Else, 1991, Southwick and Siddiqi, 1998, Chalise, 2000/1, Humle, 2003). Like elephants, many primates also have physical features that help them to consume different food types (Sukumar, 1990); for example, cheek pouches (Forthman-Quick, 1986, Warren, 2003, Priston, 2005) and prehensile attributes mean they can grip, manipulate and carry fruits, grains, roots and tubers. Even those primates unable to grasp effectively have adaptations that enable them to manipulate cultivars; for example, the aye-aye uses its elongated third finger to gain access to coconuts (Petter, 1977). However, feeding ecology is not the only factor that makes primates effective crop raiders. They are very intelligent and this can make crop protection difficult; monkeys can climb fences and baboons quickly habituate to scare devices or scarecrows (Biquand *et al.*, 1994, Strum, 1994, Priston, 2005). Furthermore, many primates live in social groups (Else, 1991) and use sophisticated communication to warn each other of danger (Cheney and Wrangham, 1987). A recent review of 121 primate species known to consume crops suggests that they are most likely to have a large geographical range and belong to either the great apes or old world monkeys, thus be large bodied and terrestrial (Ross and Hill, 2006). Interestingly, neither intelligence nor dietary quality was a significant predictor of whether a species crop raids or not.

**Table 2.2. Examples of primates that reportedly damage agricultural crops or fruit plantations; please note that some references refer to farmer interviews and personal observations as opposed to monitoring of agricultural areas (see also Priston 2005, Lee and Priston 2005). Taxonomic groups are taken from Wolfheim 1983.**

| Common Name | Latin Name | Conservation Status* | Location | Reference |
|---|---|---|---|---|
| LORISIDAE | | | | |
| Potto | *Perodicticus potto* | Least Concern | Cameroon | (Pimley 2006, *pers comm*) |
| Allen's bushbaby | *Galago alleni* | Least Concern | Cameroon | (Pimley 2006, *pers comm*) |
| Greater bushbaby | *Galago crassicaudatus* | Least Concern | Tanzania | (Kano, 1971) |
| Slow loris | *Nycticebus coucang* | Least Concern | Southest Asia | (Wolfheim, 1983) |
| LEMURIDAE | | | | |
| Mongoose lemur | *Eulemur mongoz* | Vulnerable | Madagascar | (Tattersall, 1998) |
| Brown lemur | *Lemur fulvus* | Least Concern | Madagascar | (Ganzhorn and Abraham, 1991) |
| Crowned sifaka | *Propithecus v. coquereli* | Endangered | Madagascar | (Ganzhorn and Abraham, 1991) |
| Greater sportive lemur | *Lepilemur mustelinus* | Least Concern | Madagascar | (Ganzhorn and Abraham, 1991) |
| W. woolly lemur | *Avahi l.occidentalis* | Vulnerable | Madagascar | (Ganzhorn and Abraham, 1991) |
| DAUBENTONIIDAE | | | | |
| Aye-aye | *Daubentonia madagascariensis* | Endangered | Madagascar | (Petter, 1977) |
| CALLITRICHIDAE | | | | |
| Saddle-back tamarin | *Saguinus fusicollis* | Least Concern | Peru | (Castro and Soini, 1978) |
| Moustached tamarin | *Saguinus mystax* | Least Concern | Peru | (Castro and Soini, 1978) |
| Cotton-top tamarin | *Saguinas oedipus* | Endangered | Panama, Columbia | (Wolfheim, 1983) |
| CEBIDAE | | | | |
| Weeping capuchin | *Cebus olivaceus* | Least Concern | Venezuala | (Kinzey *et al.*, 1988) |
| Brown capuchin | *Cebus apella* | Least Concern | Brazil, Venezuala | (Ferrari and Diego, 1995, Martinez *et al.*, 2000) |
| White-faced capuchin | *Cebus capucinus* | Least Concern | Costa Rica | (Gonzalez-Kirchner and Sainz de la Maza, 1998) |
| Black howler | *Alouatta pigra* | Endangered | Belize | (Alexander, 2000) |

| | | | | |
|---|---|---|---|---|
| Mantled howler | *Alouatta palliata* | Least Concern | Costa Rica | (Gonzalez-Kirchner and Sainz de la Maza, 1998) |
| Wooly monkey | *Lagothrix lagothricha* | Least Concern | South America | (Wolfheim, 1983) |
| Red-backed Squirrel monkey | *Saimiri oerstedii* | Endangered | Costa Rica | (Gonzalez-Kirchner and Sainz de la Maza, 1998) |
| CERCOPITHECIDAE | | | | |
| Black mangabey | *Lophocebus aterrimus* | Least Concern | DRC | (Wolfheim, 1983) |
| Crested mangabey | *Cercocebus galeritus* | Least Concern | Central Africa | (Tappen, 1960) |
| Red capped mangabey | *Cercocebus torquatus* | Least Concern | Equatorial Guinea, Central Africa | (Tappen, 1960, Jones and Sabater-Pi, 1968) |
| Sooty mangabey | *Cercocebus atys* | Least Concern | Sierra Leone | (Tappen, 1960, Harding, 1984) |
| Stump-tailed macaque | *Macaca arctoides* | Vulnerable | India | (McCann, 1933) |
| Long-tailed macaque | *Macaca fascicularis* | Least Concern | Palau, Indonesia | (Salafsky, 1993, Wheatley *et al.*, 2002) |
| Pig-tailed macaque | *Macaca nemestrina* | Vulnerable | Indonesia | (Salafsky, 1993) |
| Rhesus macaque | *Macaca mulatta* | Least Concern | India, Nepal | (McCann, 1933, Pirta *et al.*, 1997, Sekhar, 1998, Chalise, 2000/1) |
| Buton macaque | *Macaca o.brunnescens* | Data Deficient | Sulawesi | (Priston, 2005) |
| Assam macaque | *Macaca assamensis* | Vulnerable | Nepal | (Chalise, 2000/1) |
| Japanese macaque | *Macaca fuscata* | Data Deficient | Japan | (Knight, 1999, Sprague, 2002) |
| Bonnet macaque | *Macaca radiata* | Least Concern | India | (Krishnamani, 1994) |
| Toque macaque | *Macaca sinica* | Vulnerable | Sri Lanka | (Dittus, 1977) |
| Barbary macaque | *Macaca sylvanus* | Vulnerable | North Africa | (Tappen, 1960) |
| Olive baboon | *Papio anubis* | Least Concern | Uganda, Nigeria, Kenya, Tanzania | (Tappen, 1960, Mascarenhas, 1971, Strum, 1994, Naughton-Treves, 1996, Hill, 1997, Warren, 2003, Tweheyo *et al.*, 2005) |
| Guinea baboon | *Papio papio* | Least Concern | Gambia, Sierra Leone | (Harding, 1984, Starin, 1989, Barnett and Emms, 2002) |
| Yellow baboon | *Papio cynocephalus* | Least Concern | Kenya, Tanzania | (Kano, 1971, Maples *et al.*, 1976) |
| Hamadryas baboon | *Papio hamadryas* | Least Concern | Saudi Arabia | (Tappen, 1960, Biquand *et al.*, 1994) |
| Chacma baboon | *Papio ursinus* | Least Concern | South Africa, Kenya | (Bolwig, 1959, Gadd, 2005) |
| Vervet/ Green monkey | *Cercopithecus aethiops* | Least Concern | Kenya, Barbados, Sierra Leone, Gambia, Uganda | (Harding, 1984, Brennan *et al.*, 1985, Horrocks and Baulu, 1988, Starin, 1989, Hill, 1997, Saj *et* |

| | | | | |
|---|---|---|---|---|
| | | | Tanzania | *al.*, 1999) |
| Red-tailed monkey | *Cercopithecus ascanius* | Least Concern | Uganda | (Tappen, 1960, Naughton-Treves, 1996) |
| L'hoest monkey | *Cercopithecus l'hoesti* | Least Concern | Uganda, DRC | (Tappen, 1960, Andama and McNeilage, 2003) |
| Blue/ Sykes monkey | *Cercopithecus mitis* | Least Concern | Uganda, Zanzibar | (Hill, 1997, Siex and Struhsaker, 1999, Tweheyo *et al.*, 2005) |
| Mona monkey | *Cercopithecus mona* | Least Concern | West Africa | (Wolfheim, 1983) |
| Red-eared guenon | *Cercopithecus erythrotis* | Vulnerable | Cameroon | (Wolfheim, 1983) |
| Sclater's guenon | *Cercopithecus sclateri* | Endangered | Nigeria | (Oates *et al.*, 1992) |
| Black & white colobus | *Colobus guereza* | Least Concern | Uganda | (Tappen, 1960, Naughton-Treves, 1996, Hill, 1997) |
| Western red colobus | *Procolobus badius* | Endangered | Gambia | (Starin, 1989) |
| Zanzibar red colobus | *Procolobus kirkii* | Endangered | Zanzibar | (Siex and Struhsaker, 1999) |
| Maroon langur | *Presbytis rubicunda* | Least Concern | Indonesia | (Salafsky, 1993) |
| Silvered langur | *Trachypithecus cristatus* | ** | Malaysia | (Bernstein, 1968) |
| Hanuman langur | *Semnopithecus entellus* | Least Concern | Nepal, India | (Mohnot, 1971, Pirta *et al.*, 1997, Sekhar, 1998, Chalise, 2000/1, Rao *et al.*, 2002) |
| Nilgiri langur | *Semnopithecus johnii* | Vulnerable | India | (Poirier, 1971) |
| Patas monkey | *Erythrocebus patas* | Least Concern | Gambia, Sahel | (Starin, 1989, Ezealor and Giles, 1997) |
| Talapoin monkey | *Miopithecus talapoin* | Least Concern | Gabon, Eq Guinea | (Tappen, 1960, Jones and Sabater-Pi, 1968) |
| Drill | *Mandrillus leucophaeus* | Endangered | Cameroon | (Wolfheim, 1983) |
| Mandrill | *Mandrillus sphinx* | Vulnerable | Cameroon | (Tappen, 1960, Wolfheim, 1983) |
| PONGIDAE | | | | |
| Bornean orang-utan | *Pongo pygmaeus* | Endangered | Indonesia | (Salafsky, 1993) |
| Sumatran orang-utan | *Pongo abelii* | C. Endangered | Sumatra | (SOCP, 2006) |
| Mountain gorilla | *Gorilla beringei* | Endangered | Uganda | (Madden, 1999, Biryahwaho, 2002) |
| Western lowland gorilla | *Gorilla gorilla* | Endangered | Cameroon | (Cousins, 1978) |
| Bonobo | *Pan paniscus* | Endangered | DRC | Nishida 1972 |
| Chimpanzee | *Pan troglodytes* | Endangered | Uganda, Guinea, West Africa | (Naughton-Treves, 1996, Hill, 1997, Humle, 2003, Tweheyo *et al.*, 2005, Hockings, 2006) |

* Conservation status – as defined by IUCN Red List 2006 (IUCN 2006) **Taxonomy disputed. In Bernstein's paper (1968) it is *Presbytis cristata* and this is amended to *Trachypithecus cristatus* in Rowe (1996). It is not listed as either in IUCN Red List (2006).

The utilization of agricultural crops by primates is frequently attributed to a lack of resources[8]. Forest fragmentation means that species may need to supplement their diet with human foods (Richard *et al.*, 1989, Strum, 1994, Tweheyo *et al.*, 2005). Indeed, as many primates are fruit eaters (thus limited by seasonal fluctuations in availability) they have to be flexible and able to utilize alternative food sources in order to survive (Krishnamani, 1994). This is supported by the fact that primate damage to agriculture often increases at times of low forest fruit availability (e.g. Naughton-Treves, 1998, Hockings, 2006). However, not all species negotiate the forest-agriculture margin only at times of shortage, for example, some macaques have been named 'weed species' due to their close interaction with humans (Richard *et al.*, 1989) and red-tailed monkeys in Uganda thrive in a fragmented environment (Chapman and Peres, 2001). In addition, it is not inevitable that primates will eat human foods if their availability increases; baboons exposed to rapid agricultural development have migrated to areas with more natural habitat (Musau and Strum, 1984, Strum, 1994). However, cultivars may represent a more efficient foraging strategy for many primate species.

The domestication of agricultural crops has consciously manipulated the natural defence systems of plants by reducing levels of secondary compounds (i.e. toxins) (Bell, 1984). This makes human foods easier to digest and nutritionally advantageous in comparison with their wild counterparts (Sukumar, 1990, Ganzhorn and Abraham, 1991, Strum, 1994). Agricultural crops are also spatially clustered and offer predictable 'packages' of nutrition (Strum, 1994, Naughton-Treves, 1998). Primates are, therefore, able to gain more energy for less effort; foraging time is reduced and they can spend supplementary time resting and socializing (Oyaro and Strum, 1984, Forthman-Quick, 1986, Eley *et al.*, 1989, Strum, 1994, Saj *et al.*, 1999, Warren, 2003). Animals that regularly consume human foods also tend to have higher reproductive rates (Lee *et al.*, 1986) and be in better physical condition, i.e. larger with more fat and

[8] It is important to note that on occasion primates have been actively encouraged to eat human foods. For example, chimpanzees in Tanzania and macaques in India have been provisioned to aid behavioural research (Wrangham, 1974, Krishnamani, 1994, Wallis and Lee, 1999). Due to their revered status, many monkeys are provisioned at temples or religious sites in Asia (Southwick *et al.*, 1983, Zhao, 2005). Vervet monkeys have also been fed to enable tourists to gain a better view of wildlife (Starin, 1989).

fewer parasites (Eley *et al.*, 1989). While there are clearly benefits to utilizing agricultural crops as a foraging strategy, there are substantial costs. Primates are at risk from injury and disease as the congregation of many animals at feeding sites can increase competition and aggressive encounters (Wrangham, 1974, Brennan *et al.*, 1985, Imam *et al.*, 2002, Warren, 2003). In addition, animals are exposed to associated risks whilst traveling and foraging in human areas e.g. electrocution from power cables and the possibility of fatal disease transmission (Eley *et al.*, 1989, Wallis and Lee, 1999). Primates can also be vulnerable if they become dependent on an artificial food supply; for example, the closure of a rice mill in Sri Lanka resulted in increased competition for resources with neighbouring groups of macaques (Dittus, 1977). Furthermore, animals can be killed by angry farmers trying to protect their livelihoods; baboons, Syke's monkeys and capuchins have been killed in the Gambia, Kenya and Costa Rica respectively (Fitzgibbon *et al.*, 1995, Gonzalez-Kirchner and Sainz de la Maza, 1998, Barnett and Emms, 2002). In South Africa, the problem was acute enough that entrepreneurs saw a market in baboon meat; a scheme was proposed whereby problem animals would be processed into canned meat for human consumption and their body parts sold for 'sex stimulants' (Brend, 1999)[9]. Clearly primate crop raiding poses a considerable risk to both the farmer and the animal. This is even more significant when one takes into account the conservation status of many primate species.

Many primate crop raiders embody the phenomenon of the 'endangered pest' (Knight, 2000a) and their utilization of human foods is a conservation issue (Hill, 2005). Whilst the majority of problem species are considered low risk, approximately forty percent of those listed in Table 2.2 are classed as either vulnerable or endangered due to deforestation, hunting, persecution and use in traditional medicine (e.g. Tappen, 1960, Poirier, 1971, Nishida, 1972, Petter, 1977, Southwick *et al.*, 1983, Chapman and Peres, 2001). This is a real concern as primates play a vital role in international conservation. In addition to their ecological importance, e.g. seed dispersal (Paterson,

[9] The proposed scheme has been dropped after campaigns from conservationists highlighted that it could increase the demand for bush meat and body parts (Brend, 1999)

1991, Chapman, 1995, Chapman and Peres, 2001), primates are often used as 'flagship species' to gain support for environmental initiatives (Walpole and Leader-Williams, 2002) and they can attract considerable foreign exchange from tourism (Siex and Struhsaker, 1999). The utilization of agricultural crops can undermine these activities and weaken support for conservation (Strum, 1994, Tweheyo *et al.*, 2005); for example, gorillas habituated for tourists attack farmers and cause considerable loss to agricultural crops in Uganda (Madden, 1999). Many primates are protected by local taboos and cultural myths but in some places this is being eroded by their 'pest' status (Oates *et al.*, 1992, Southwick and Siddiqi, 1998, Knight, 1999, Imam *et al.*, 2002, Humle, 2003).

Clearly primate crop raiding requires further research and Budongo Forest Reserve (BFR) is suited to a study of this type as the villages around its boundary are experiencing increasing human-wildlife conflict (see Chapter 1). Prior to examining the actual and perceived risk of crop damage it is important to understand the historical and social context to this issue.

## 2.4 Budongo Forest Reserve

### *2.4.1 The Ecology of the Forest*

BFR lies between 1°37'N-2°03'N and 31°22'-31°46'E on the northern edge of the Albertine Rift in Masindi District, Uganda. It comprises approximately 435km$^2$ of semi-deciduous moist tropical forest and has been described as a combination of ironwood forest (dominated by *Cynometra alexandrii*), mixed forest (dominated by *Celtis sp.* and including mahoganies – *Khaya* and *Entandrophagma sp*), colonizing forest (dominated by *Maesopsis eminii*) and swamp forest (Eggeling, 1947). BFR is the largest mahogany forest in East Africa (Reynolds *et al.*, 2003) and has been managed for timber extraction since 1926[10]. In 1932, under the control of the British Protectorate, it was formally gazetted as a central forest reserve and during the 1960's was home to Uganda's biggest sawmill operation (Eggeling, 1947, Reynolds, 2005).

[10] BFR was selectively logged from this time following thorough working plans that controlled the removal and replacement of all trees (Eggeling, 1947, Plumptre and Reynolds, 1994)

Today the mill is closed and the forest is managed by the National Forestry Authority (NFA)[11]. From 1997, BFR was to be part of a joint management programme between local people and the Forestry Department which included the distribution of 40% of revenue to local communities. However, support did not reach affected groups (Lauridsen, 1999) and this arrangement is currently not part of the NFA strategy (Dezidering 2005, Budongo Forest Officer, *pers comm*).

Local people are allowed to utilize forest resources i.e. firewood, medicinal plants and water but require a permit to remove timber or rattan cane (Deziderius 2005, *pers comm*)[12]. Whilst NFA Officers do patrol the reserve, illegal logging is encountered (Lauridsen, 1999, Plumptre *et al.*, 2003a, Reynolds, 2005) and in 2006 chain saws were heard being used on a regular basis[13] (Wallace 2006, *pers comm*). This is a major concern as the mechanization of pitsawing will not only increase the quantity of timber taken but also the wastage; illegal logging is more inefficient than legal methods as there is no regulation or control of extraction (Hamilton, 1984). Numerous *Eucalyptus* plantations are also found around BFR. These are managed by the NFA and Uganda's National Forestry College which is situated in a village on the southern edge of the forest (Nyabyeya).

BFR is home to numerous duikers, birds and small mammals. In addition, six primate species are present; the blue monkey (*Cercopithecus mitis stuhlmannii*), red-tailed monkey (*Cercopithecus ascanius schmidti*), black and white colobus (*Colobus guereza occidentalis*), baboon (*Papio anubis*), chimpanzee (*Pan troglodytes schweinfurthii)* and potto (*Perodicticus potto*). Vervet monkeys (*Cercopithecus aethiops*) are also seen in the forest but mainly inhabit grassland areas (Plumptre and Reynolds, 1994). Fortunately, logging appears to have had little negative impact upon primate populations and in a recent census, BFR was reported as containing one of only four

[11] The NFA was originally a government department (Forest Department) before its inauguration in 2004.
[12] BFR is separated into three zones – 50% production (for timber extraction), 30% buffer (where the collection of fuelwood and non-timber forest products is permitted) and 20% nature reserve (where no activity is allowed). See Appendix 1 for a map of these areas.
[13] Chainsaws were not heard at NFA logging sites and therefore it is believed they were being utilized for illegal timber extraction

viable populations of chimpanzee in Uganda (Plumptre and Reynolds, 1994, Plumptre *et al.*, 2003a). There are also plans to develop a forest corridor to protect several small populations that exist outside the reserve in isolated forest patches (Plumptre *et al.*, 2003a, Reynolds *et al.*, 2003). However, there are notable absences from the biodiversity of BFR. Many large ungulates were killed during the British protectorate in an effort to stop the spread of bovine trypanosomiasis to domestic cattle by the tsetse fly (Baker, 1971)[14]. In addition, 'control' shooting to protect agricultural areas and plantations from depredations (Eggeling, 1947, Brooks and Buss, 1962, Reynolds, 2005) resulted in the elimination of elephants from BFR.

*2.4.2 The Human Population*

The villages on the southern edge of the reserve are composed of a rich diversity of ethnic groups including Lugbara, Alur, Kakwa and Lendu alongside the indigenous Banyoro[15]. After a dramatic decline in human population density prior to and during the British Protectorate[16], migrants flooded into the area attracted by resettlement programmes, abundant land and employment at cash crop estates and saw mill operations (Baker, 1971, Lauridsen, 1999). There was also a later influx of refugees due to civil unrest in neighbouring countries such as Democratic Republic of Congo, Rwanda and Sudan (Hamilton, 1984, Johnson, 1996, Hill, 1997, Marriott, 1999, Paterson, 2005). More recently, migrant labourers have moved into the area seeking employment with Kinyara Sugar Works Ltd (KSWL)[17], a large sugar estate between

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[14] The colonial government attempted to remove all large ungulates - the food supply of the tsetse fly (*Glossina sp*) – from the forest in an effort to eradicate the disease (Turner & Baker cited in Paterson 1991)

[15] Masindi District is in the traditional Bunyoro Kingdom, home of the Banyoro. The kingdom was previously a major African empire but gradually lost territory to other ethnic groups (including the Baganda) (Taylor, 1969). In 1899 the Bunyoro King (Kabarega) was defeated by the British and some of the kingdom given to the Baganda (Nzita and Mbaga, 1997). Tension between these two groups still exists today (Taylor, 1969, *pers obs*).

[16] Tribal wars and disease reduced the population in the 1800s (Eggeling, 1947). Later, colonial control of bush fires encouraged the spread of tsetse and a subsequent sleeping sickness epidemic. As a consequence, many people were evacuated from the north, west and east of BFR (Paterson, 1991). In addition, famine, influenza, syphilis and meningitis outbreaks severely reduced the human population at this time (Baker, 1971, Paterson, 1991). Cattle were also decimated by disease i.e. rinderpest.

[17] KSWL opened in 1976 but was closed in 1985 due to political instability. It was recommissioned in 1995 under the management of Booker Tate Ltd and now has an annual turnover of sh26b and is planning to increase production capacity to 93,000 tonnes. It is in the process of being privatised (Muwanga, 2005, Doya, 2006, KSWL, 2006)

BFR and Masindi (Reynolds *et al.*, 2003). However, the closure of the saw mills and decline of other plantations has meant that many workers have become increasingly dependent upon subsistence agriculture. Previous studies reported that at least seventy percent of the population rely on farming as their main or sole source of livelihood (Hill, 1997, Tweheyo *et al.*, 2005).

*2.4.3 Threats to the Reserve*

Like many other protected areas in Africa, BFR faces a number of threats. The population of Uganda is increasing rapidly (UBOS 2005). Whilst Masindi District currently has one of the lowest population densities in the country (UBOS, 2005), it is predicted that the human population around BFR will double every 25 years (Marriott, 1999). This rise in density has already seen the rapid conversion of forest to agriculture and nearly sixteen percent of tree cover was lost in this area between 1986/7 and 2001 (Plumptre *et al.*, 2003b). In addition, a large area of woodland has been converted to sugar cane with the reopening of KSWL (Reynolds *et al.*, 2003, Tweheyo *et al.*, 2005). International companies (i.e. KSWL and British American Tobacco) are also encouraging local people to grow cash crops on their land as part of outgrower programmes[18] (Plumptre *et al.*, 2003a, Reynolds *et al.*, 2003).

The rise in agriculture and outgrower programmes is having a fundamental impact upon the environmental and social landscape around BFR. Soil quality is likely to degenerate; it has been argued that cultivation of food crops is not the most appropriate use of this land due to its low level of organic resources (Paterson, 1991). The removal of tree cover is also believed to be contributing to a shortage of water and fuel wood[19] in this area (Hamilton, 1984, Klunne and Mugisha, 2001, Reynolds *et al.*, 2003). Although the majority of forest has been removed from unprotected land, as resources dwindle, increasing pressure will be placed on local people to utilize BFR (Plumptre *et*

[18] Outgrowers are local farmers who enter into a contract with companies to use private land for the cultivation of cash crops. Generally the company bears all initial costs (the land is prepared and the farmer is supplied with seedlings/ fertiliser). These costs are then subtracted from the profit of the sale of the crop to the company at harvesting.

[19] 97% of households in Uganda rely on forest products (i.e. firewood or charcoal) for cooking (UBOS, 2005)

*al.*, 2003b). Whilst outgrower schemes have the potential to generate important income in impoverished areas, there is evidence that both sugar cane (as above) and tobacco can impact negatively on the environment (Geist, 1999, Plumptre *et al.*, 2003a)[20], undermine traditional systems of production (Robbins, 1995) and cause significant social stress by forcing a local rise in the price of food crops. In addition, farmers absorb all risks and are vulnerable to loss from factors outside their control e.g. the weather and financial markets. BFR, and the local people who depend upon it, are also at risk from international exploitation of its resources. Significant levels of oil have been found in nearby Lake Albert (Busharizi and Kasita, 2006) and uranium is also present in this area (Ssonko, 2004). These developments could be a serious concern to future conservation and human development around the reserve (Plumptre *et al.*, 2003b).

More positively, there is a strong conservation presence in this area of northwest Uganda. BFR is the site of long-term field research; the Budongo Forest Project (BFP) was formed in 1990 primarily to examine issues pertaining to chimpanzee ecology. A number of local non-governmental organisations (NGOs) have also been formed in the Masindi District to support conservation initiatives and community development programmes – the most prominent being Budongo Forest Community Development Organisation (BUCODO). This is in addition to frequent work by international conservation agencies, including the Wildlife Conservation Society (WCS) and the Jane Goodall Institute (JGI).

### *2.4.4 Threats to the Wildlife*

A number of wild animals regularly consume food and cash crops around BFR including baboons, bushpig, monkeys, porcupines and chimpanzees (Hill, 1997, 2000, Tweheyo *et al.*, 2005). Baboons are particularly problematic as they cause significant damage and are much reviled by local people (Hill, 1997, 2000). Despite growing antagonism to chimpanzees raiding sugar cane in this area (Plumptre *et al.*, 2003a,

[20] These impacts can be indirect, for example most of the snares in use in this area are made from wire taken from KSWL as opposed to traditional lianas (Tumusiime, 2004, Reynolds, 2005)

Reynolds *et al.*, 2003), most farmers are still tolerant of their presence and do not actively hunt them. However, they are at risk from farmers trying to protect fields from problem species (Chapter 1). In addition, bush meat hunting is common in the BFR despite the national ban (Johnson, 1996, Plumptre *et al.*, 2003a) and protected animals can be injured by snares left in the forest to capture game species (Sicotte and Uwengeli, 2002). A snare removal programme is underway to reduce this conflict and over 230 snares were removed in the first month alone (Quiatt *et al.*, 2002, Plumptre *et al.*, 2003a, Reynolds, 2005). A new design of live trap was also recently introduced to reduce the incidence of trap injuries to chimpanzees and protect agriculture from 'vermin' species (Plumptre *et al.*, 2003a, Reynolds, 2003). However, many local people did not perceive the traps to be an effective strategy and the units were not maintained (Webber *et al.*, In Press)[21].

The consumption of human foods by primates is one of many social and environmental issues that impact upon livelihoods around BFR. This is a site undergoing rapid change; the population is rising, natural resources are being depleted and local people are more reliant on agriculture due to the loss of employment opportunities. Any examination of human-wildlife conflict must be understood in this context.

[21] This refers to research that was conducted as part of this project but is not included in the thesis. The paper is currently 'in press' and is included in Appendix 11.

# 3. METHODS

## 3.1 Introduction

Data were collected for thirteen months between February 2004 and November 2005 (detailed information regarding study periods is found in Appendix 2). Fieldwork seasons were split as it was necessary to return to the UK to input spatial data, verify co-ordinate systems and utilize mapping software which was not available remotely. It was also important to examine the issue of crop damage during peak periods of agricultural activity and thus heightened actual and perceived risk. Therefore, the study seasons were structured to coincide with traditional growing seasons in Masindi District.

Records since the 1930's indicate that Budongo Forest Reserve has one dry season from December to February and that most of the year is wet with peaks of rainfall from April to May and August to October (Eggeling, 1947, Taylor, 1969, Paterson, 1991, Tweheyo *et al.*, 2005). The farming calendar is dominated by this bimodal pattern and planting coincides with the onset of the rains in March/April and August (Figure 3.1). The primary growing season is from March to July and the main maize crop is grown at this time (Hill, 2000). This period of agricultural intensity was the initial focus of the study and data were collected from April to August in both 2004 and 2005 (Study Season 1 and 2):

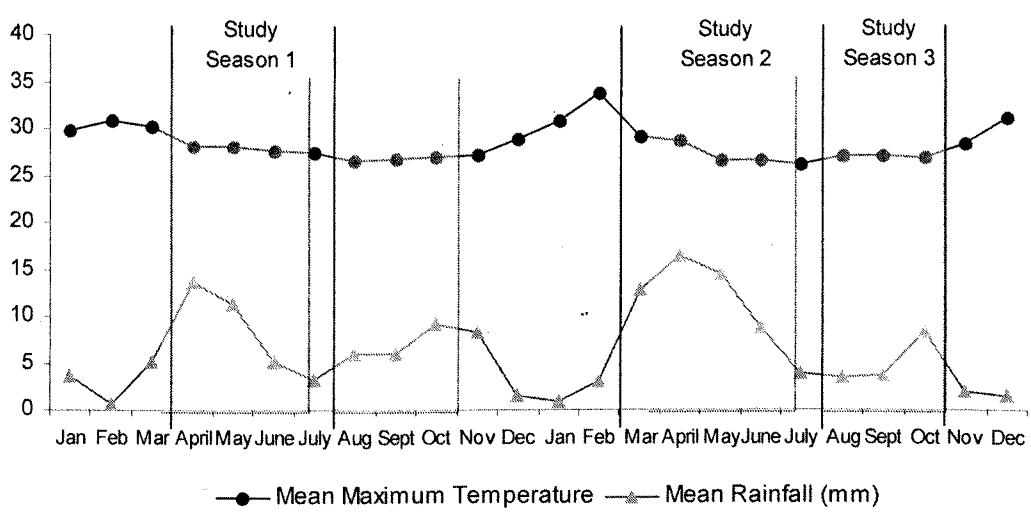



**Figure 3.1 Mean maximum temperature (°C) and rainfall (mm) over the three study seasons (2004 and 2005)[22]. Shaded areas depict traditional growing seasons.**

[22] Rainfall and temperature data supplied by Budongo Forest Project.

However, in order to identify seasonal variation it was also important to incorporate data from the secondary growing season (August to end of October). This period was included in 2005 and is referred to in this thesis as Study Season 3.

### 3.2 Study Villages

The research study focuses on four villages on the southern edge of the BFR; Kyempunu, Nyabyeya II, Fundudolo and Nyakafunjo (Figure 3.2). The villages were selected as they are all on the edge of either the main forest block or a forest fragment and are within 90 minutes walking distance from Nyabyeya Forestry College (the central meeting point for the research team). In addition, three villages chosen were from a sample studied between 1992 and 1994 (Hill, 1997, 2000) and consequently, offer a valuable and unique opportunity to examine crop-raiding issues in the context of a changing social, ecological and economic environment.

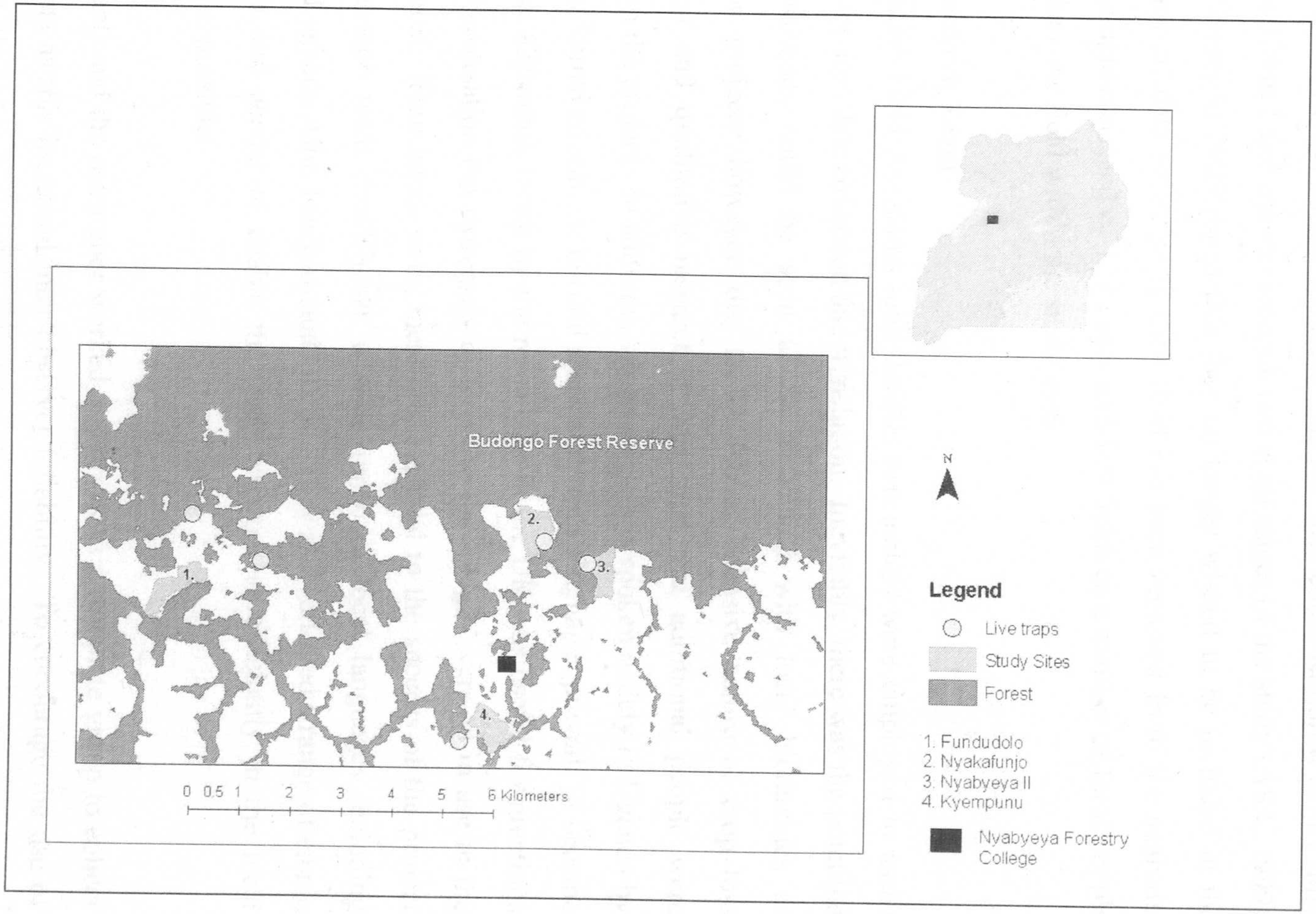
As Figure 3.2 illustrates, an area of land (1km x 0.5km) next to the forest edge was identified in each of the villages (after Naughton-Treves, 1996). These study sites were all utilised primarily for agricultural purposes and therefore incorporated a complex combination of fields, buildings, fallow and bush areas[23]. Similar landscape features were taken into account as much as possible.

All farmers within the study plots were approached to take part in the study. Village Council Chairmen[24] were visited and advised on the correct procedure for recruiting local people. Each farming family was contacted separately to gain their approval for the project. This process took a considerable length of time but it was important to build up a relationship of trust with local people before initiating data collection. Written consent was not felt to be appropriate for this study for a number of reasons; all those recruited were adults aged sixteen and over, many local people are illiterate and the culture is predominately based on an oral tradition.

[23] Fallow is used to define agricultural land that has previously been cultivated but is now 'resting'. Bush is used to define non-forested land that is not planted with food crops and has never been cultivated.

[24] Village Councils are elected bodies and take the place of traditional chiefs in Uganda. They were established by President Museveni and the National Resistance Movement (NRM) as 'resistance councils' and are now fully integrated into the current political system (Wild and Mutebi, 1997)

Figure 3.2 Map showing the location of the four study sites in relation to Budongo Forest Reserve and Nyabyeya Forestry College (inset Uganda country map)



The research study was outlined verbally to each farmer to ensure their consent was informed and they were aware of all information that could affect their decision to take part – see Appendix 3 (ASA, 1999); their participation in the project was considered as consent. It was also stressed to local people that their involvement in any element of the research was voluntary and that they could withdraw at any time. This was reaffirmed and consent renegotiated at all stages of the study (ASA, 1999). Only one farmer in 2005 stated that they no longer wished to be included in the research project; data collected in their field has been removed from the analysis. The final sample consisted of 129 farms and 169 fields as a number of local people had more than one field within the study area.

### 3.3 The Research Team

Three Ugandan Field Assistants (one female, two males) were employed to assist with both crop loss data collection and translation. Inevitably, there was the potential that the assistants could be seen to be associated with local hierarchies or conservation projects; however, due to the labour intensive nature of crop loss measurement and qualitative research it was vital that additional people were employed on the project. In addition, whilst English is spoken widely in Uganda by those with a formal education, in rural areas numerous languages prevail. It became apparent that KiSwahili learnt by the researcher in the UK was useful for greetings and basic conversation but extremely different to the 'pidgin' version in use in the Nyabyeya area. Translators were, therefore, essential to the success of the project and the research team could speak a wide range of local languages including KiSwahili, Lugbara, Alur, Runyoro and Okebu. They also reflected a range of ethnic backgrounds and gender to enable the study to work as efficiently in the local community as possible.

Field assistants and the researcher worked in pairs or as a complete group to collect crop loss data as this increased inter-observer reliability. To encourage the use of individual skills and a sense of responsibility for the research, each member of the team was given a specific area of expertise; for example, land use maps or crop inventories. Research meetings were also held once a week where everyone could discuss issues related to the project or general topics that might have a bearing on the research; for example several very interesting sessions took place discussing myths and the utilization of trees/ animal species by different ethnic groups.

### 3.4 Measuring Actual Crop Loss

Each of the four study plots was surveyed for crop damage by wild and domestic species at weekly intervals. Whilst there has been considerable variability in the frequency of previous assessments of crop damage (see Hill, 2000, Andama and McNeilage, 2003, Gillingham and Lee, 2003) weekly monitoring has been used at other sites of 1km x 0.5km and thus could offer valuable comparative data (Naughton-Treves, 1996). It was important to examine tracts of land as opposed to a particular number of fields so that spatial effects could be analysed from the perspective of the animal (wild or domestic) and not be defined by the boundaries of agricultural units. Field monitoring will be discussed further in Chapter 5.

#### *3.4.1 Spatial Data*

A GPS – Global Positioning System - (Silva MultiNavigator or Garmin Legend) was used to store spatial data such as the corner points of each farm, buildings and the location of the forest boundary. These data were then downloaded directly from the GPS to Garmin Mapsource Trip and Waypoint Manager v2 (Garmin International Inc, Kansas). To ensure that all data were using the same projections, GPS locations were checked with hard copy datasheets. These points were then converted from latitude/ longitude co-ordinates to decimal degrees and digitized using ARCGIS9 and ARCMAP (ESRI – Environmental Systems Research Institute, California). Field points were then joined to create accurate representations of each agricultural unit (polygon data). These were overlaid on maps of forest cover (United Nations Food and Agriculture Organisation Africover Project) and forest loss (supplied by Dr Nadine Laporte of the Woods Hole Research Centre, US) – Figure 3.3[25]. The latter were created from satellite images of the field site between 1986/7 and 2001 and depict estimates of forest loss around BFR. The size of each farm (polygon) was calculated using the area function within ARCGIS.

[25] Further information on the creation of these land change maps is found in Plumptre *et al* (2003b). It should be noted that it is not possible to differentiate between degraded and regenerating forest.

Figure 3.3 Farm boundaries in a) Kyempunu, b) Nyakafunjo and Nyabyeya II, and c) Fundudolo overlaid on maps of forest loss (created from the comparison of satellite imagery (1986/7 and 2001))

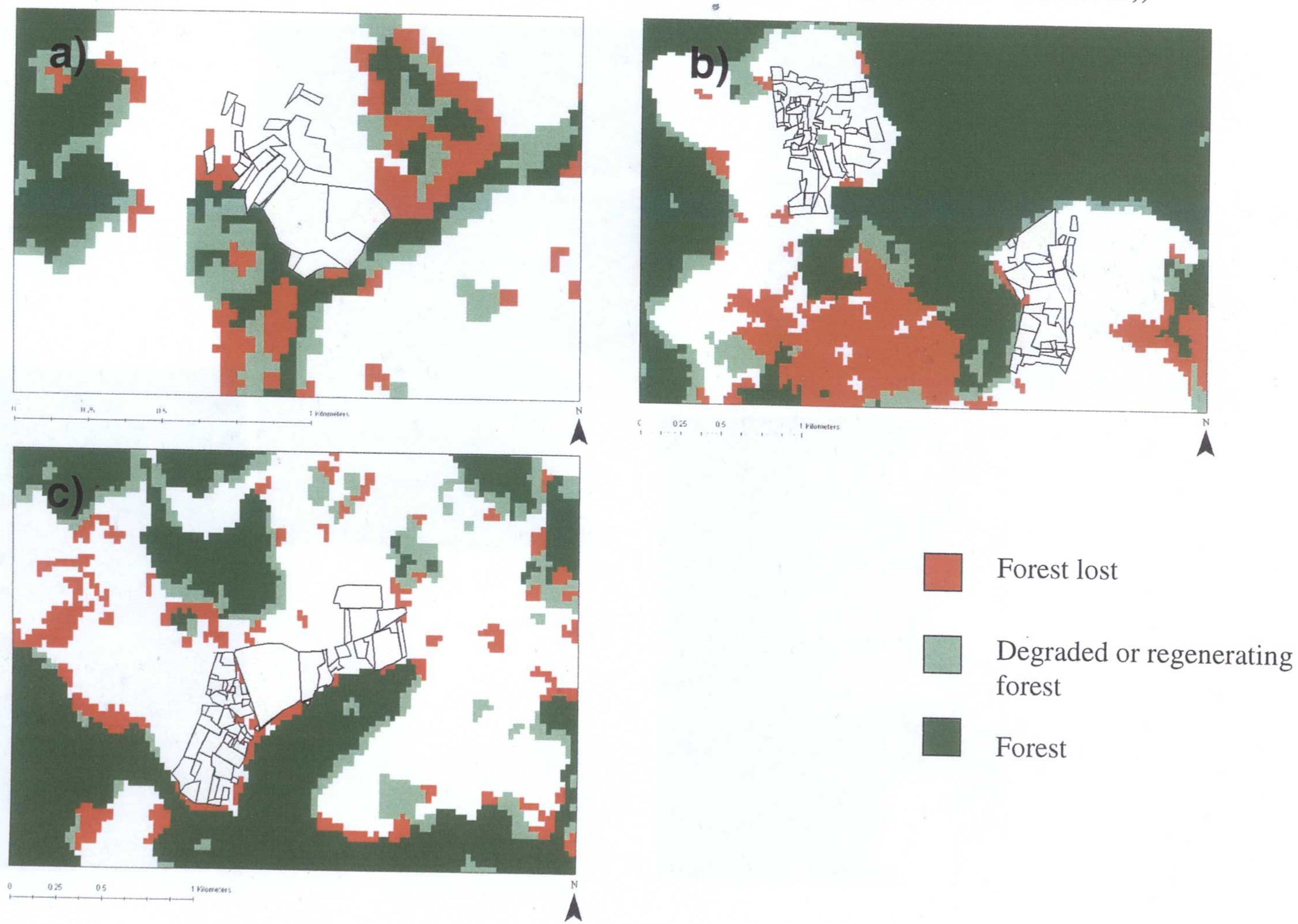
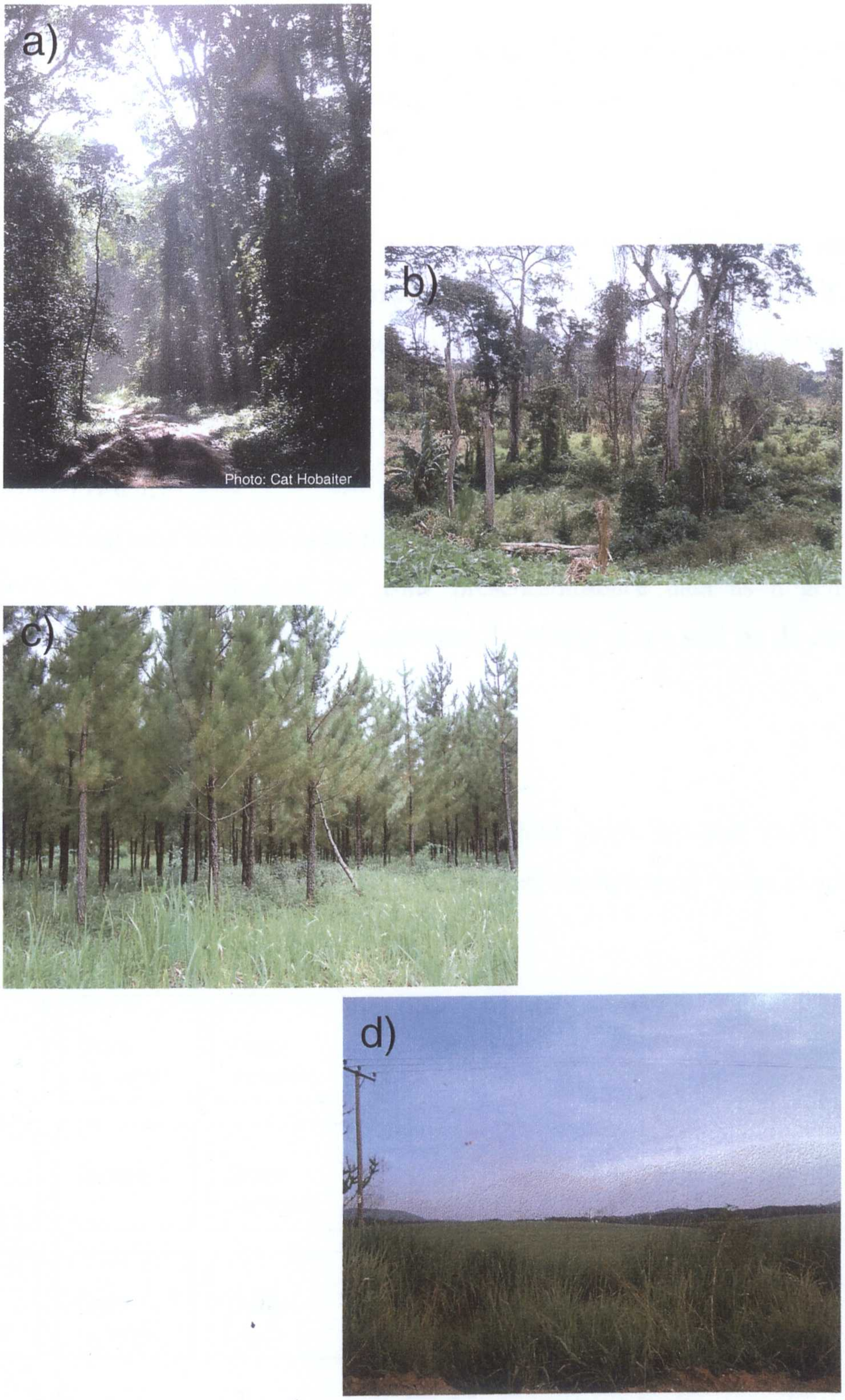


**Figure 3.4 Photographs depicting land use categories used in analysis; a) forest, b) degraded forest, c) plantation, d) sugar cane**



Land use was also mapped for every season within each study area and one hundred metres outside the boundary with the following mutually exclusive categories; forest, degraded forest, plantation (*Eucalyptus* or teak), field, fallow, bush, tobacco or sugar cane (see Figure 3.4 for some examples).

The location of all crop protection methods encountered (e.g. snares and scarecrows) were also stored in a GPS and digitized on return from the field.

### *3.4.2 Crop Inventories*

The number and type of crops grown were assessed for each field and recorded during each study season. The average planting density was ascertained for measurable crops (after Hill, 2000) by selecting four random samples and obtaining the mean number of stems grown/ crops sown in a $100m^2$ area.

### *3.4.3 Farmer Presence*

Whilst conducting crop loss data collection in the field, farmers' presence or absence was recorded. The justification for using presence/absence data as a general indication of the labour commitment undertaken to protect crops will be discussed further in Chapter 7.

### *3.4.4 Goat Damage Study*

To ascertain the impact of domestic species on field crops, a small study was conducted in July 2005 that examined the effect of goat damage upon maize yield:

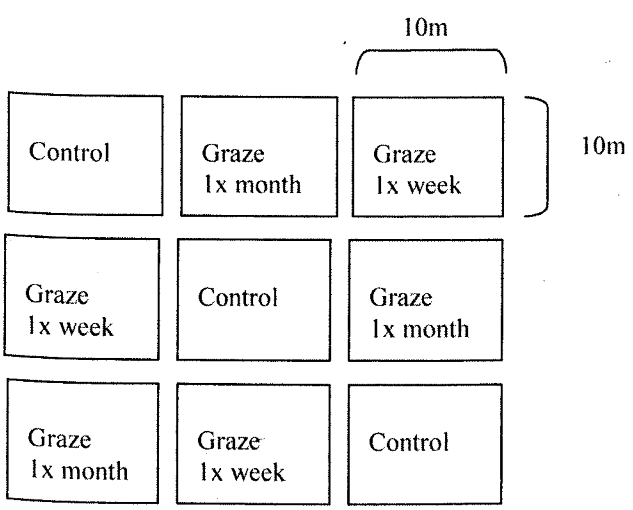



**Figure 3.5 Diagram of the layout of the goat damage trial**

In a farm belonging to one of the assistants (Jackson Okuti) with the generous donation of seed by Fred Babweteera (Director of BFP), nine study plots (10m x 10m) were planted with maize. Three control plots were left to grow without intervention, three were pruned by goats once a month and three once a week Nine plots were used to account for any potential variation in soil acidity, termite presence, water levels etc. A token amount was paid to rent the land with the agreement that any harvest from the project could be used by the owner. In addition, funds were given to employ labourers to prepare the land, plant the crop and undertake weeding as necessary. The maize yield (length and weight of each cob) was then compared for each experimental condition.

*3.4.5 Limitations of Measuring Actual Crop Loss*

Selection of the study areas was difficult as no research site was exactly the same in terms of local forest habitat, distribution of primate species and location of key landscape features. Indeed an element of variation was necessary in order to analyse their potential effects upon crop damage. One unforeseen problem was the destruction of extensive sections of forest fragment during the short lifespan of this study. All sites have experienced loss of forest over recent years (see Figure 3.3) but in some areas the majority of tree cover was removed (Figure 3.6).

Measuring farms in preparation for weekly crop monitoring was also problematic. In 2005 many farmers left previously used fields fallow and/or were clearing areas that were not planted the previous year. This made the creation of three land use maps, one for each field season, a necessity. Another point to note is that many fields were irregular shapes so, where this occurred, numerous corner points were taken in order to get as accurate a measurement of field size as possible.

Records of crop damage events are also potentially conservative due to the presence of crop protection methods e.g. leg-hold traps[26]. In order to protect the safety of the research team, existing paths and boundaries of the crop stand were used to avoid walking through the centre of a field and therefore triggering a potential trap

[26] Leg-hold traps are large, spring-loaded metal devices that snap shut on the leg of any animal (or person) that steps into them (Reynolds, 2005).

**Figure 3.6 Photographs depicting the extent of forest loss in villages around Budongo Forest Reserve**

mechanism. This inevitably made it more difficult to see damage in fields of tall, dense, mature crops e.g. cassava.

### 3.5 Examining Perceptions of Crop Loss

Perceptions of the risk of crop damage were examined using a number of qualitative data collection techniques including semi-structured interviews (SSIs), focus groups and participant observation.

#### *3.5.1 Semi-Structured Interviews*

SSIs were used to examine local people's perceptions of crop loss and specific raiding species. Unlike more structured techniques, the SSI allows researchers to discover what the study population believe is important (Drever, 1995, Bryman, 2001c) as opposed to simply the investigator's view of it (Rossman and Rallis, 1998). The combination of open and closed questions used within SSIs also allows the participant to have an element of control over the interview experience (Drever, 1995), they can influence the direction of the questions and, ultimately, the research. As Holstein and Gubrium (1995) have argued, a research interview should be an 'active' process, a social interaction as opposed to simply the extraction of information. This participatory element makes the SSI a highly flexible technique (Drever, 1995, Bryman, 2001c) one that allows the researcher to probe and clarify key points (Drever, 1995) but with considerable freedom in response. Interestingly, many attitudinal studies completed for conservation projects have used questionnaire surveys (e.g. Infield, 1988, Newmark *et al.*, 1993, Gillingham and Lee, 1999, Conforti and de Azevedo, 2003). However, they can be restrictive, extractive and not always appropriate for investigating illegal or sensitive topics (De Boer and Baquete, 1998, Hill *et al.*, 2002) such as human-wildlife conflict. For this type of data, a SSI is a more appropriate research technique.

The interviews also assist integration into the community; people like to have their views 'heard' (Gilham, 2000) and SSIs are a useful technique to build rapport with local people (Hill *et al.*, 2002). The SSI is also informal, face to face and allows for the communication of non-verbal information (Drever, 1995). Initially a dictaphone was to be used but this was felt to be too intrusive, particularly regarding potentially sensitive issues (Bryman, 2001c). In addition, this was an unfamiliar technology within the research sample and, therefore, had clear associations with formality. Instead notes were taken during the interview and a researcher's log written which recorded my thoughts and feelings on the interview, the general progress of the research process and the participants' mood/dress/interactions (Pretty *et al.*, 1995, Rossman and Rallis, 1998, Gilham, 2000, Bryman, 2001c).

The interview questions were piloted with two local people who were part of the same study population (Drever, 1995, Gilham, 2000) but not included in the final data collection or analysis, and the research team. One person was approached from every farm within the study area and all SSIs were conducted in the villages or fields at a time and location that was convenient to the participant. This resulted in a sample of 104 individuals.

*3.5.2 Focus Groups*

Focus groups were used to further examine issues and perceptions introduced in the SSIs. They are, fundamentally, 'group interviews' usually consisting of participants who have something in common and a moderator who guides the dialogue (Morgan, 1998, Kreuger and Casey, 2000, Bryman, 2001b). However, rather than be a question and answer session, focus groups are concerned with discussion, the 'group norms' that guide this interaction and the meanings behind group communication (Bloor *et al.*, 2001, Bryman, 2001b). They were chosen as an appropriate method of qualitative research for this project as they encourage in-depth discussion of a key topic and allow participants to compare experiences in order to support or refine their own opinions (Morgan, 1998, Bryman, 2001b). In addition, focus groups were considered an important method for this study as I could 'triangulate' findings as part of the multi method design (Bloor *et al.*, 2001). They were also useful as they required few facilities or specialized equipment which made them ideally suited for use in the field.

Focus groups are also a useful arena for group exercises, for example those used as part of Participatory Rural Appraisal/ Participatory Learning and Action methods (see Pretty *et al.*, 1995, Chambers, 2002). Visual techniques can be particularly effective when working with communities that have a range of literacy levels and are a useful stimulus for discussion (Pretty *et al.*, 1995). Ranking exercises are also valuable in studies of this type as they (i) make those involved really consider an issue (Kreuger and Casey, 2000) thus diverting attention from potential differences and power inequalities (Pretty *et al.*, 1995), (ii) give participants a sense of ownership and control over the process (Pretty *et al.*, 1995, Chambers, 2002) and (iii) assist in analysis across the groups (Bloor *et al.*, 2001). As Kreuger and Casey (2000) describe, another advantage to this type of exercise is that by "using criteria developed by each person....you get closer to their reality" (p.49).

Farmers were randomly sampled as representatives from each study area; five men and five women. The exception was Kyempunu where only five men were selected due to the small sample size and gender skewed nature of the study plot. Although recruiting few people to a group does increase the risk of poor attendance and limited interaction, using small numbers of participants can be useful as a more natural setting for discussion (Bloor *et al.*, 2001). A total of 31 people took part in the group sessions.

### *3.5.3 Participant Observation*

Participant observation is a data gathering method whereby researchers observe and record the behaviour of individuals within a particular group or setting (Bryman, 2001a). It was used to collect information about costs of crop damage, attitudes towards wildlife and local authorities and crop protection techniques and took place in fields and social settings, both within and outside of the study sites. An important element of participant observation is building rapport with local communities and becoming immersed in their culture (Bryman, 2001a). Informal 'do-it-yourself' sessions (Pretty *et al.*, 1995, Chambers, 2002) were spent with local people; I learnt to hoe, plant and weed key subsistence crops.

### *3.5.4 Limitations of Examining Perceptions of Crop Loss*

Perhaps the most significant limitation of SSIs is that they contain "an inherent bias which often conflicts with the understanding rural people have of the nature of knowledge and information and therefore of the meaning of questions and answers" (Mitchell and Slim, 1991, p.68). Western culture is based on the assumption that there are answers to every question and that knowledge is the expression of these solutions, as opposed to rural Africa where questions can be open and 'mystery' is acknowledged (Mitchell and Slim, 1991). It is important to be aware of this limitation in order to avoid potential misinterpretation of data; vague answers can indicate the "enormous complexity in the question and the impossibility of nutshelling" (Mitchell and Slim, 1991, pg 71). Another limitation of SSIs, and verbal methods as a whole, is that participants may talk about performing particular activities but this may not be an accurate representation of everyday life (Gilham, 2000). However, for this study people's 'perceptions' of the issue were important and by monitoring farms on a weekly basis we were aware of actual action.

Participatory rural appraisal techniques (often including the SSI or a similar interview process) have often been used with rural communities by development programmes and therefore there may be an element of expectation from the participants (e.g. Naughton-Treves, 1996, Biryahwaho, 2002, Hill *et al.*, 2002, Quinn *et al.*, 2003). This is especially significant around BFR as there has been a plethora of short term projects that have left communities frustrated with their lack of outcome (Lauridsen, 1999). Local people can also feel threatened by involvement in research projects or exaggerate their need if such projects are viewed as a potential opportunity (Mitchell and Slim, 1991, Siex and Struhsaker, 1999). It was, therefore, vital to keep emphasizing to local people that this research was neither funded beyond subsistence nor being conducted on behalf of a future intervention programme. I would instead stress that the problems the study group were reporting would be communicated to local NGOs and government offices through reports that are conditional to undertaking fieldwork in Uganda.

Another difficulty arose when trying to retain positions of equality whilst conducting the SSIs (Drever, 1995, Gilham, 2000); in Ugandan culture a visitor is given a seat on entry to the compound. Where possible, I tried to keep on the same level as the participant (e.g. sitting in the field, on a mat in front of the house, tree trunk), however, there were a number of occasions where seats were offered to the research team and to refuse would have appeared rude and insensitive of cultural norms. In this situation the interviewee sat on the floor or on a lower level to the interviewer.

The use of translators in SSIs has obvious limitations. The tone of voice used by the interviewer can alter the context of a question (Gilham, 2000) and words can be chosen by the translator that are 'loaded' with hidden meanings or do not accurately represent the original statement. Nuances in the local language can also be lost in 'back-translation' (Rossman and Rallis, 1998). To counteract this, questions were piloted and the research team spent a considerable amount of time discussing their exact meanings. It is consequently believed that the use of translators did not prevent the research team from obtaining useful data on the perceptions of local people regarding crop damage and attitudes to specific raiding species.

One of the main limitations of using focus groups was with regard to sustaining group discussion. This was made more noticeable because I do not speak a local language fluently. Thus the facilitator needed to translate in addition to moderate the group which disrupted the natural flow of the discussion. Participants also seemed to be very comfortable with, and in anticipation of, a question and answer format. This made it difficult to generate group interaction on an issue despite the encouragement of the facilitator and research team. This limitation may be associated with cultural expectations; traditionally, village meetings in this area are dominated by one or two main speakers (often the most powerful members of the society) and the community is allowed to ask questions. Participants did appear to view our group meeting as being a very different experience from what they were used to; as one farmer told us, "it isn't like a meeting...we are learning...it is like education".

There was a definite advantage to using 'indigenous researchers' as moderators for the focus group process; participants were more relaxed and the assistants had a good understanding of all the topics of conversation. However, it must also be recognized that it could have a negative effect on data collection through "mere over-familiarity through reticence to shame and repugnance" (Bloor *et al.*, 2001, p.18). I noticed that field assistants did react differently to specific individuals; in the groups, interviews and general social situations. Obviously it is difficult to completely eliminate any cultural hierarchies from research of this nature but I stressed the importance of creating a comfortable environment for all many times in an effort to limit any bias.

### 3.6 Statistical Analysis

SPSS v12.0.1 (SPSS Inc, Chicago, IL) was used for all statistical analyses. As the data were frequently categorical or of a small sample size, nonparametric statistics were most appropriate for identifying significant differences and correlations (Siegel and Castellan Jr, 1988). Chi-square, Kolmogorov-Smirnov, Kruskal Wallis, Cramer's V and Spearman's Rank were all used to analyse study data. In addition, backward binary logistic regression was used to identify the significance of key environmental variables on raid presence. This is discussed in detail in Chapter 5. All tests are two tailed unless otherwise stated and results considered significant if $p<0.05$. Graphs were created in SPSS or Microsoft Excel (Microsoft Corp, Redmond, WA). Bonferroni adjustments (statistical corrections for multiple tests) were not used as they can increase the likelihood of type II errors (Perneger, 1998) and are not appropriate for exploratory research (Bender and Lange, 1998). In the presentation of results, means are used as it is believed that they give a better indication of the 'average' amount of loss incurred by those farmers experiencing crop loss. If median figures are presented, the high number of farms that do not experience raids could skew our understanding of actual crop damage.

The SSIs and focus groups were analysed using qualitative techniques; 'exhaustive' and 'exclusive' categories were assigned to the interview notes (Gilham, 2000) and these were organized to identify key trends (Pretty *et al.*, 1995). Manual techniques, such as the use of coloured pens were used to highlight the coding process (Drever, 1995, Gilham, 2000). As neither method was taped, this study relied upon notebased analysis (Morgan, 1998). This has the advantage of being quicker, (Kreuger and Casey, 2000), but it cannot include the same level of depth as taped transcriptions as not every detail of interaction can be feasibly recorded. It has been argued that academic focus groups should only be conducted if they can be analysed through transcription (Bloor *et al.*, 2001), however, in this study it was felt that meaningful data could be collected from notes and that this would be the least invasive method of data collection. A risk index was also created to ascertain local people's perceptions of crop raiding proportional to other risks and the process will be explained in more detail in Chapter 6.

### 3.7 Ethical Considerations and Data Protection

Oxford Brookes University Research Ethics Committee granted ethical clearance in December 2003 for all stages of the project (Appendix 4).

It was important to follow cultural traditions when recruiting local people to the project and hence existing political structures were used in this research. By approaching farmers separately they were able to make an informed choice regarding participation without pressure from other individuals (Drever, 1995, Gilham, 2000). However, hierarchies and social tension exist within any gathering where the participants are well acquainted (Morgan, 1998, Bryman, 2001b). Thus every effort was made to keep the group sessions relaxed, informal and accessible to all.

Another ethical issue was to ensure that the research did not have any adverse effects upon its subjects. Most farmers are extremely busy during these peak periods of agricultural activity and it was important not to create a further burden. The majority of interviews were conducted in farmers' fields so that individuals were able to continue with their work if they wished. The research team were also careful not to cause additional damage to agricultural crops whilst monitoring loss.

To ensure the sample were adequately protected, participants were advised that their information would be anonymised throughout data collection, analysis and any subsequent publications arising from the research (ASA, 1999). However, this caused an unexpected problem and one individual was quite angry at this approach; by not taking his personal details, it appeared to him that we were not taking his views seriously. From that point on we asked each participant if they wanted to give their name, every farmer did and their personal information was recorded separately in order to retain anonymity in analysis and reporting.

It is important that participants are kept adequately informed of research progress and results. Therefore, the Council Chairmen were told verbally of project progress throughout the study and in February 2005, a short summary of results from the first study season was also distributed and discussed (Appendix 5). This was written in English as all Village Chairmen, as part of their role, are expected to read and write in English. However, it was discussed in a local language to ensure there was no misinterpretation. In addition, a final meeting was held in each study area to evaluate the research. Such gatherings are important in the development of future projects and to further the learning of both the facilitators/research team and the participants (Chambers, 2002). It was also important to manage farewells appropriately as we had been fully integrated into the community (Bryman, 2001a). Therefore, meetings took place in the compound of a centrally located farming family and two members of each household were invited. Soft drinks were provided as a way of thanking local people for their attendance. The meeting began with a summary of the project and what I and the research team felt we had gained from the experience before asking farmers to discuss their views of the study and suggestions for improvement (Chambers, 2002). At the end of the meeting, all participating families were thanked and given a small gift of soap and salt that was believed to be a relevant and 'fair return' for their assistance (ASA, 1999).

Regarding data protection, in the UK all codes and identifying information were stored in separate locked cabinets and access to the computer files was by password only. Access was by the named researcher only. Whilst in the field, a lockable box was obtained to store all hard data and when a laptop was used it was password protected to ensure confidentiality. As data are for the purpose of research, it may be used in the future to advance/ develop knowledge and/ or for publication. This will be produced to the same guidelines as the original research; all personal data will remain confidential and anonymised in publication. However, if it is considered that any data are surplus to requirements they will be disposed of carefully; hard copies shredded, disks and tapes erased. A form (without personal information) will also be used to record the type of data/ location/ data initiated and date destroyed.

# 4. RESULTS: DEMOGRAPHICS OF THE STUDY SAMPLE

## 4.1 Introduction

As outlined in the methods section, the study sample comprised 129 farms located within four study sites (Kyempunu, Nyabyeya II, Fundudolo and Nyakafunjo). A total of 169 fields were monitored as several farmers owned more than one field. Demographic information was obtained for 104 farms.

**Table 4.1 Total number of fields, farms and the proportion of farmers interviewed in each study area**

| *Village* | *Total Number of Farms* | *Total Number of Fields* | *Number Interviewed* | *Percentage Interviewed* |
|---|---|---|---|---|
| Kyempunu | 18 | 23 | 16 | 88.8% |
| Nyabyeya II | 26 | 38 | 21 | 80.7% |
| Fundudolo | 42 | 53 | 29 | 69% |
| Nyakafunjo | 43 | 55 | 38 | 88.3% |
| **Total** | 129 | 169 | 104 | 80.6% |

There is a significant difference in the number of local people interviewed across the field sites ($\chi^2$=10.63, df=3, $p<0.05$). Fewer semi-structured interviews (SSIs) were conducted in Fundudolo and this is probably due to the restricted time available at the site; Fundudolo is the furthest study area from Nyabyeya Forestry College, the meeting point for the research team (see Figure 3.2).

## 4.2 Gender

Attempts were made to obtain an even division of men and women, however there is a significant difference in distribution by gender ($\chi^2$=3.846, df=1, p=0.05); almost 60% (N=104) of the sample is male. This difference is not significant at the village level.

## 4.3 Age

It is not possible to analyse the age of respondents statistically due to small sample size (chi-square). However, age is not normally distributed (Kolmogorov-Smirnov Z=2.392, $p<0.01$) and 37.5% (N=104) of the sample are aged 46 or above. In addition, those in Kyempunu are proportionally much older than in the other three villages. It is not possible to extrapolate from these data that the village populations are different in terms of age distribution because only one person was interviewed from each household. However, personal observation does indicate that Kyempunu has an aging population.

### 4.4 Education

A high number of interviewees have not been to school (26.2%, N=103) which is comparable with national population statistics; 27% of those aged over 15 in Uganda have no schooling (UBOS 2005). The majority of the sample (63.2%) have some primary education but only 10% continued to senior level. There is a significant difference in the education levels of men and women ($\chi^2$=7.458, df=1, p<0.01); 83.6% (N=61) of men had received some form of education in contrast with only 59.5% of women (N=42). This is slightly less than the average for women across the country - 65% of women in Uganda attended school on some level (UBOS 2005).

### 4.5 Ethnicity

Twenty different ethnic groups are represented within the interview sample and there is a significant difference in their distribution when aggregated into the four primary groups; West Nile (northwest Uganda), Congolese (Democratic Republic of Congo), Banyoro (indigenous group) and other ($\chi^2$=53.3, df=3, p<0.01) – see Table 4.2. Previous studies have reported a much higher percentage of the indigenous Banyoro in this area than are found in the study sample; in 1959, 80% of people in the district were from this ethnic group (Taylor, 1969) but by 1996 this had reduced to 12% (Paterson, 2005).

Due to the small sample size, it is not possible to examine the statistical significance of ethnicity upon education levels. However, some interesting general observations can be made when the data are grouped into educated/ not educated. All of the Banyoro respondents (N=5) have some level of education and 86% of the Congolese (N=22) while only 71% of those people from West Nile attended school (N=56).

**Table 4.2 Ethnic Composition of the Study Sample (N=104)**

| *Ethnic Group* | *Frequency* | *Percentage* |
|---|---|---|
| *Banyoro* | 5 | 4.8% |
| *West Nile/ Northwest Uganda*<br>Incl. Lugbara, Alur | 56 | 53.8% |
| *Congolese (DRC)*<br>Incl. Lendu, Okebu | 23 | 22.1% |
| *Other*<br>Incl. 5 from Uganda, 3 from Kenya, 1 from Rwanda and 1 from Sudan | 20 | 19.2% |

## 4.6 Farm Size

Size of farm is not normally distributed across the study sample (Kolmogorov-Smirnov $Z=2.612$, $p<0.01$); 35.7% of participants have farms of less than $2000m^2$/ 0.2 hectares and almost a third (30.2%) have farms of over $6000m^2$/0.6 hectares (N=129). Mean farm size, however, is small ($6503m^2$/ 0.65 hectares). It should be noted that mean farm size may be inflated by several large farms in the sample; median farm size ($3781m^{2/}$ 0.37 hectares) indicates that many local people own farms smaller than the mean. This skew towards smaller farms at the study site is further emphasized by mean field size (which takes into account the fact some farmers own multiple fields) at only $5555m^2$/ 0.55 hectares. See Appendix 6 for a more detailed breakdown of farm features.

Farm size is negatively correlated with distance from animal habitat (Spearman rho=0.271, N=129, $p<0.01$); among the study group, the larger the farm the more likely it is to be closer to forest, degraded forest or plantation. There is no significant difference between farm sizes at each of the study sites (chi-square).

## 4.7 Distance from Forest

The majority of farmers (58.1%, N=129) cultivate fields within 250m of forest, degraded forest or plantations. Just over one quarter (27.1%) have farms that adjoin the forest and only 19 farms (14.7%) are further than 250m. There are some differences at village level. Farms in Nyabyeya II are evenly distributed by distance from forest.

This is in contrast with Nyakafunjo where few farms adjoin forest but 76.7% (N=43) are within 250m of animal habitat. This is a result of areas of bush and fallow being situated between fields and the boundary of BFR (Figure 3.3). In Kyempunu and Fundudolo the majority of farms are within 250m or adjoining forest or degraded forest (94.4%, N=18 and 90.4%, N=42 respectively).

### 4.8 Main Earner

Almost 70% of the study sample (N=103) are dependent on agriculture for their livelihood. This is comparable with previous studies (Hill, 1997, Tweheyo *et al.*, 2005) and the national figure of 68% (UBOS 2005). Other sources of income include local conservation projects (i.e. Budongo Forest Project - BFP), Kinyara Sugar Works Ltd - KSWL (within the factory, outgrower scheme or as a sugar cane guard), Nyabyeya Forestry College (night watchmen), teaching and small business ventures such as carpentry, brewing and fishmongery.

Whilst the sample size is too small for statistical analysis (chi-square), there are some interesting comparisons between the indigenous Banyoro and the migrant groups regarding employment; 95.6% of Congolese (N=23) and 67.2% of those from West Nile (N=55) are farmers. In contrast, only 40% of Banyoro (N=5) rely on agriculture to bring money into the household. Age is also a significant factor ($\chi^2$=14.441, df=3, $p<0.01$) with 89.4% (N=38) of those over 46 dependent upon farming.

There is no significant difference in the main earner of the household when grouped by village or education (when lumped into educated/ non educated).

### 4.9 Wealth

Wealth was estimated for each farming family by counting the presence of specific indicator variables; livestock (goats, chickens and pigs), bicycle, radio, iron sheets (roofing in contrast to traditional grass materials), other sources of income apart from farming, other fields outside the study area and a farm larger in size than the median for this sample (3781m$^2$). Previous studies in East Africa have indicated that a combination of these features are useful indicators of wealth (e.g. Bush *et al.*, 2004, UBOS 2005) A point was given for the presence of each indicator to a maximum of nine. Clearly this is a rudimentary measure as it is based on a number of assumptions; (i) farmers do not have a home (and thus potentially iron sheets) elsewhere and (ii) selling excess food crops at market does not earn as much income as external employment. It also does not differentiate between farmers growing food or cash crops. Cash crops are not included in the analysis as they are dependent upon financial markets and thus their value can fluctuate. Other variables are not included as they can be both economically advantageous and disadvantageous; for example, the number of people living in the household can be a strain on resources but extra labour can reduce costs during periods of agricultural intensity (Bush *et al.*, 2004).[27]

Wealth indicators are only normally distributed for this study sample at a low probability level (Kolmogorov Smirnov Z=1.479, N=103, $p<0.05$). Thirty three percent of the sample have between one and three indicators and 53.3% have between four and six indicators (N=103). Very few farmers are found at either extreme of wealth; only 6.8% have either no wealth indicators or more than six. Although the sample size is too small to analyse wealth indicators by village, a high proportion of those in Nyabyeya II (85.7%, N=21) and Nyakafunjo (62.1%, N=37) own more than four indicators. There is a significant positive correlation between wealth and education (Spearman rho=0.342, N=102, $p<0.01$); as education increases so does the frequency of wealth indicators present in the household. Wealth is also negatively correlated with age (Spearman rho=0.402, N=103, $p<0.01$). In addition, wealth is distributed differently between ethnic groups; 32% of those from West Nile (N=55) have between one and three indicators, in contrast, 56.5% of Congolese (N=23) and 80% of Banyoro (N=5) have more than four.

[27] Whilst these data give a general indication of wealth at the four study sites, it is recognised that a participatory wealth ranking approach (whereby local people are asked to identify and rank items) may have been a more accurate and informative method (see Naughton-Treves, 1996, de Merode *et al.*, 2004, Priston, 2005)

When the wealth indicators are broken down into individual components (Table 4.3), it becomes clear that not all are distributed in the same way; pigs and iron roofs are owned by far fewer of the sample than any other of the commodities.

**Table 4.3 Percentage of wealth indicators present in each village (N=103[a], N=101[b], N=129[c], N=76[d]), bold figures depict the highest percentage for that category. *Comparative percentages are taken from the 2002 national census for rural areas (UBOS 2005)**

| *Village* | *Goat* [a] | *Chicken* [a] | *Pig* [a] | *Bicycle* [b] | *Radio* [b] | *External Income* [a] | *Iron Roof* [c] | *Other Fields* [d] | *Large Farm* [c] |
|---|---|---|---|---|---|---|---|---|---|
| Kyempunu | 62.5 | 56.3 | 12.5 | 43.8 | 50 | 27.8 | 0 | 25 | 38.8 |
| Nyabyeya II | **66.7** | 71.4 | **28.6** | **61.9** | **71.4** | 19 | 3.8 | **76.5** | **61.5** |
| Fundudolo | 41.4 | **72.4** | 0 | 44.8 | 65.5 | 27.6 | 7.1 | 36.8 | 54.7 |
| Nyakafunjo | 43.2 | 59.5 | 13.5 | 57.1 | 60 | **37.8** | **18.6** | 53.6 | 48.8 |
| **Total** | 50.5 | 65 | 12.6 | 52.5 | 62.4 | 29.8 | 9.3 | 50 | 51.9 |
| **Uganda*** | - | - | - | 35.7 | 45.4 | 22.9 | 49.5 | - | - |

Chicken ownership is similar across the entire sample, however, goats were owned by a smaller proportion of farmers in Fundudolo and pigs by more farmers in Nyabyeya II than any other village[28]. The use of iron sheets as roofing is much lower than the national average for rural areas and this could be a reflection of the high poverty levels around BFR. However, it could also be an indication that a number of farmers have a main homestead elsewhere. Bicycle ownership, in contrast, is higher than the national average and could be due to employment as many companies/ groups in the area have schemes to assist members of staff with transport. Indeed, 81.2% of those who do not own bicycles are farmers (N=48). Bicycle ownership could also be connected to proximity to markets (Table 4.4).

The twice weekly Karongo Market is the largest market in the area. Local people can buy and sell food produce and traders from Masindi are often present selling material items (e.g. cooking pots, shoes, secondhand clothes, school books). Nyabyeya II is furthest from this market and this may be a reason for the high proportion of bicycles in this village.

[28] Very few cows were seen in this area. They were traditionally kept by the Banyoro (Johnson, 1996) but many were killed in epidemics of rinderpest and bovine trypanosomiasis (Paterson, 1991).

**Table 4.4 Proximity of villages to Karongo Market**

| *Village* | *Distance from Market* |
|---|---|
| Kyempunu | 4.2km |
| Nyabyeya II | 6.3km |
| Fundudolo | 3.7km |
| Nyakafunjo | 5.7km |

Nyabyeya II is close to another market (Kinyara). However, this is not utilized by many farmers in this sample as it is strongly influenced by its proximity to KSWL and prices are inflated due to the high number of employed personnel in this area[29]. The only difference that is statistically significant between the villages is regarding ownership of fields outside the study area ($\chi^2$=9.223, df=3, $p<0.05$); only one quarter of interviewees in Kyempunu (N=12) and approximately one third in Fundudolo (N=19) own other farms, in contrast with Nyabyeya II where 76.5% (N=17) own fields outside the study area.

## 4.10 Number of People Living in the House

The majority of the sample have between 1 and 5 people in their household but almost 30% (N=102) have between 6 and 10. Four interviewees have more than 16 people living and sleeping within their homestead.

## 4.11 Time Living in Area

Time living around BFR shows a dichotomous distribution; 13.9% have been in the area for less than five years but 11.9% have been resident for more than thirty one years (N=102). The distribution differs by ethnicity; 60% of Banyoro (N=5), 47.8% of Congolese (N=23) and 50% of other (N=20) have lived on the southern edge of BFR for over 21 years. Thirty five percent of those from West Nile have been in the area for less than 5 years but 25.9% have lived in these villages for more than 21 years (N=54). Distribution by village is very similar. There are some differences regarding time in

[29] It is held on the last Saturday of the month to coincide with payday for factory workers (Lauridsen, 1999)

the area when analysed by the main earner of the household. Over half (55.6%) of those running small businesses have lived in Nyabyeya parish for more than 21 years. Farmers and illegal pitsawers are more polarized in their distribution; the highest categories for both earning types are 1-5 years (30.6% and 42.9% respectively) and over 21 years (40.3% and 42.9% respectively).

### 4.12 Crops Grown

A total of thirty four food crops or fruit trees are grown in farms around BFR and one farmer grew twenty three different foodstuffs (Table 4.5). Not all crops are intentionally cultivated (e.g. chilli) but if they can be used as a food for the family or be sold at market then they were included in the crop inventory. Cassava and maize are the most frequently grown crops at the four study sites with more than 80% of farmers cultivating one of them on their land. Fruit trees such as mango, pawpaw and jackfruit are also commonly observed in farms around BFR. The majority of crops are for home consumption or for sale in the market; however tobacco and sugar cane are cultivated as cash crops in this area. The number of farms growing food crops is not statistically significant across the three study seasons (chi-square). However, it is clear that the number of fields planted with food crops falls from season 1 to 3:

**Table 4.6 Number of fields under cultivation in the study area (N=169)***

| *Land Use Type* | *Season 1* | *Season 2* | *Season 3* |
|---|---|---|---|
| Food Crop | 152 | 149 | 125 |
| Maize | 127 | 122 | 89 |
| Cassava | 119 | 115 | 90 |
| Sweet Potato** | 36 | 56 | 69 |
| Cash Crop*** | 44 | 17 | 8 |
| Sugar Cane | 5 | 5 | 6 |
| Tobacco | 39 | 12 | 2 |
| Fallow | 1 | 15 | 37 |
| **Percentage under Food Crop** | 89.9% | 88.1% | 73.9% |

* Fields are used in this analysis so that the number of fallow areas can be calculated accurately; rarely are entire farms fallow, rather they are split into cultivated and fallow sections.
** Sweet potato was included here as, whilst it is only ranked 9th in frequency of observation in farms, it was a significant feature of planting regimes in study season 3.
*** Only fields where all or a substantial area is used for tobacco or sugar cane cultivation are recorded; some farmers grow very small amounts for personal consumption

**Table 4.5 Food crop and its rank according to frequency grown in sample farms (N=129)**

| *Rank* | *Local Name* | *Other Names* | *Latin Name* |
|---|---|---|---|
| 1 | Cassava** | Manioc/ Tapioca | *Manihot esculenta (bitter) & Manihot palmata (sweet)* |
| 2 | Maize [c] | | *Zea mays* |
| 3 | Banana* | Plantain | *Musa sp.* |
| 4 | Yam | Cocoyam/ Taro | *Colocasia esculenta* |
| 5 | Mango | | *Mangifera indica* |
| 6 | PawPaw | Papaya | *Carica papaya* |
| 7 | Jack Fruit | | *Artocarpus heterophyllus* |
| 8 | Bean/ Pea [a] | | *Vigna sp.* |
| 9 | Sweet Potato | | *Ipomoea batatas* |
| 10 | Pineapple | | *Ananas comosus* |
| 11 | Sugar Cane* | | *Saccharum officinarum* |
| 12 | Pumpkin | | *Curcurbita sp.* |
| 13 | Tobacco | | *Nicotiana tabacum* |
| 14 | Aubergine | Egg Plant | *Solanum melongena* |
| 15 | Sorghum | Guinea corn | *Sorghum bicolor* |
| 16 | Avocado | | *Persea Americana* |
| 17 | Coffee | | *Coffea sp.* |
| 18 | Okra | Lady's finger | *Abelmoschus esculentus* |
| 19 | Chilli | | *Capsicum frutescens* |
| 20 | Passion Fruit | | *Passiflora spp.* |
| 21 | Groundnut | Monkey-nut/ Peanut | *Arachis hypogaea* |
| 22 | Millet | Finger millet | *Eluesine coracana* |
| 23 | Orange | | *Citrus sp.* |
| 24 | Simsim | Sesame/ Benniseed | *Sesamum indicum* |
| 25 | Tomato | | *Lycopersicon lycopersicon* |
| 25 | Soya Beans | | *Glycine max* |
| 26 | Onion | | *Allium cepa* |
| 27 | Rice | | *Oryza sp.* |
| 28 | Soursop [b] | Brotherheart | *Annona sp.* |
| 29 | Cabbage | | *Brassica oleracea* |
| 29 | Castor | | *Ricinus communis* |
| 30 | Sunflower | | *Helianthus annuus* |
| 31 | Guava | | *Psidium sp.* |
| 31 | Potato | Irish Potato | *Solanum tuberosum* |

* Few farmers grew complete fields of cane or banana; the rank is high as some individuals have one or two plants on their farm

** There are two types of cassava (bitter and sweet). They are prepared in very different ways; only sweet can be picked and eaten immediately, bitter must be dried and is usually pounded into flour

[a] Beans and peas are aggregated as identification and names can be confusing (e.g. cowpea is another name for the black-eyed bean). This group includes the cowpea and pigeon pea.

[b] Identification was made using a photograph from the field. This fruit tree was called 'brother heart' by the sample but I cannot find evidence of this name as a means of identifying the plant. The 'custard apple' is known as the 'bullock's heart' but the fruit looks very different.

[c] The prevalence of maize is a recent development and reflects the large number of migrants in this area; the indigenous Banyoro traditionally cultivate sweet potato, millet, sorghum and banana (Taylor, 1969). It also reflects a campaign by the Ugandan government during the late 1980s to increase maize cultivation for foreign exchange; acreage doubled in Masindi at that time (Nyangabyaki, 1991)

The crops grown are also different for the three seasons (Table 4.6). Maize and cassava are grown less frequently in Season 3 but sweet potato cultivation increases at this time (from 21.3% to 40.8% of fields, N=169). The reduction in food crops planted in Season 2 and 3 is due to an increase in land left fallow as opposed to an increase in the cultivation of cash crops in the area.

**4.13 Summary**

Analysis of the study sample reveals an economically poor and vulnerable population. Over one third of interviewees are over 46 years old with few wealth indicators and little education. A high proportion of women, more than the national average, are also uneducated. The majority of the sample is reliant on subsistence agriculture and grows a high number of food crops. Yet many have small farms, at least five dependants and few opportunities for any external income. However, some individuals are more economically independent; a small number grow cash crops, almost one third have another source of income and half own at least one other field. The villages of Nyabyeya II and Nyakafunjo appear to be wealthier than the other sites, with a higher proportion of wealth indicators. The Banyoro and Congolese respondents often have alternative sources of revenue and seem to be wealthier than other local people. Those from West Nile are poorer than other ethnic groups in this area.

The mixed ethnicity of the sample reflects the migration of workers to Masindi District for work in sawmills and large cash crop estates; a high proportion of those from West Nile, Democratic Republic of Congo and other locations have been living around BFR since the early 1980's. However, there is some indication that people from West Nile are still migrating to this area as over one third of this ethnic group have been in Nyabyeya parish for less than five years. In contrast, the low proportion of Banyoro close to BFR suggests that, in addition to a district level decline in their numbers, migrants are disproportionally represented on the forest edge. This has been recorded elsewhere in Uganda (Naughton-Treves, 1997).

# 5. RESULTS: ACTUAL CROP LOSS AND INDICATORS OF VULNERABILITY

## 5.1 Introduction

Subsistence farming in the tropics is subject to many limitations; the weather, water availability, soil quality, weeds, birds, pathogens and viruses all damage valuable food crops (Yayock *et al.*, 1988, Chitere and Omolo, 1993, Oerke and Dehne, 2004). In addition, a global focus on monocultures has reduced crop diversity thus making plants particularly vulnerable to insect damage (Dixon *et al.*, 2001, Oerke and Dehne, 2004). As has been previously outlined (Chapter 2), a high number of animals also eat human foods. In Uganda, baboons, monkeys, elephants and bush pig all consume or trample agricultural crops (e.g. Naughton-Treves, 1996, Hill, 1997, Andama and McNeilage, 2003, Kagoro-Rugunda, 2004, Paterson, 2005, Tweheyo *et al.*, 2005). Livestock can also be problematic (Naughton-Treves, 1996, Warren, 2003). However, raids by domestic animals are rarely documented in the literature, despite the fact that grazing by feral populations (e.g. goats) has a significant impact upon vegetation levels (see Coblentz, 1978).

There is a need for evidence based research in conservation (Sutherland *et al.*, 2004) and without measuring crop loss it will not be possible to ascertain if reports of human-wildlife conflict are due to actual damage, exaggerations, misidentifications or the increase in media and political interest (Mascarenhas, 1971, Bell, 1984, Naughton-Treves, 1996, Hoare, 1999, Knight, 1999, Siex and Struhsaker, 1999). In addition, it will not be possible to develop effective mitigation strategies (Van Vuren and Smallwood, 1996, Naughton-Treves, 1998) that are designed to target specific animals and features of their raiding environment. However, it is not only important to record what is being eaten, it is also essential to identify factors that may influence the probability of damage. Few studies have systematically attempted to do this (Siex and Struhsaker, 1999) yet highlighting areas of vulnerability will be more effective in assisting farmers to maximize their yield than estimates of total loss (Somers and Morris, 2002).

Proximity to forest habitat has been highlighted as a key variable that can increase the probability of crop damage in tropical areas. Indeed, the majority of raids by wild vertebrate species are reported to be within 300m of the forest boundary (e.g. Naughton-Treves, 1996, Hill, 1997, Madden, 1999, Saj *et al.*, 2001, Andama and McNeilage, 2003, Warren, 2003, Priston, 2005, Tweheyo *et al.*, 2005). Distance from animal habitat or natural forage also has an impact on the level of conflict with prairie dogs, moose and birds (Zinn and Andelt, 1999, Tourenq *et al.*, 2001, Seiler, 2005). The research suggests that those living closest to animal habitat (i.e. forest) or nest sites will experience the most damage from wildlife. However, it is important to examine other factors that may influence the movement and foraging of crop raiding species. For example, distance from fallow areas is significant at some sites of human-wildlife conflict as it is believed to act as a wildlife 'refuge' (Naughton-Treves, 1997, Andama and McNeilage, 2003, Gillingham and Lee, 2003). In addition, proximity to human settlements (Madhusudan, 2003, Sitati *et al.*, 2003, 2005) and migration routes (Sukumar, 1990) are predictors for crop damage by elephants, and bird damage is associated with the distance from perching trees on the edge of fields (Somers and Morris, 2002). The number of fields between a farm and animal habitat has also been found to be significant in some studies as local people benefit from the vigilance and crop protection of their neighbours (Bell, 1984, Hill, 1997, Naughton-Treves, 1997).

Seasonal variation may also impact upon the distribution of crop damage; raid events are frequently connected to the presence of human foods and a decline in natural forage (see Mascarenhas, 1971, Petter, 1977, Musau and Strum, 1984, Dardaillon, 1987, Biquand *et al.*, 1994, Strum, 1994, Naughton-Treves, 1996, Siex and Struhsaker, 1999, Peine, 2001, Humle, 2003, Reynolds *et al.*, 2003, Tweheyo *et al.*, 2005, Hockings, 2006). This would suggest that the risk of crop damage by large vertebrates is not consistent throughout the year but is subject to peaks of intensity. However, there is some evidence that animals will raid even if natural forage is available (Sukumar, 1990, Warren, 2003). Previous research also suggests that crops are not equally vulnerable to damage; maize and cassava often experience considerable loss (Dardaillon, 1987, Naughton-Treves, 1996, Hill, 2000, Chalise, 2000/1, Gillingham and Lee, 2003, Weladji and Tchamba, 2003, Priston, 2005). It is not clear whether animals are being selective in their depredations or simply eating the crops that are most frequently grown (Hill, 1997, Naughton-Treves, 1997, Saj *et al.*, 2001, Andama and McNeilage, 2003, Warren, 2003, Priston, 2005). Cash crops can also be vulnerable to depredations i.e. cardamom, cacao and sugar cane are all eaten by primates (Chalise, 2000/1, Humle, 2003, Reynolds *et al.*, 2003). Sugar cane is a particular problem because it is available all year, has a high potential economic value and is frequently eaten by endangered animals, i.e. chimpanzees (Naughton-Treves *et al.*, 1998, Reynolds *et al.*, 2003, Tweheyo *et al.*, 2005).

The aims of this chapter are:

- To identify the main causes of crop damage around BFR
- To ascertain if there is any difference in the risk presented by different raiding species, especially primates
- To identify factors that affect vulnerability to crop loss by domestic and wild animals

## 5.2 Methods

### *5.2.1 Farm Monitoring*

All farms (N=129) were visited on a weekly basis and canvassed for crop damage by large animals (2kg and above). A damage event (raid) was defined as any area of continuous crop loss attributable to one species. It should be noted that there are two distinct categories that define crop damage; the plant can be used as part of a feeding strategy or damaged accidentally. The majority of examples are in the former, however loss from species such as cow and buffalo appears to be non-nutritional; crops are mainly destroyed through trampling not foraging. It is important to include this sample however, as they are still losses that must be carried by the farmer. The central point of each raid was entered into a GPS and this was repeated where more than one crop was damaged. The animal responsible and crop type/ part/ maturity were recorded on a datasheet (Appendix 7). It is important to standardize crop loss measurement in order to enable effective comparison across sites, therefore the information included in the data sheet was largely directed by Hill *et al.*, 2002. Due to the paucity of observed raids, secondary evidence was used to identify raiding species. If two pieces of evidence could not be found (e.g. dental impressions or spoor) or the damage was more than one week old then the raid was recorded as *ad hoc*. This was to ensure that the classification of raiding species was as accurate as possible. For example, differentiating between animal damage and the cultivation practices for tobacco can be difficult because farmers tear the flower heads and top leaves from the stem as part of the growing cycle.[30]

Due to the difficulty in distinguishing between secondary evidence from monkey species, data from red-tailed monkeys, blue monkeys, vervet monkeys and black and white colobus monkeys are aggregated. It should be noted that red-tailed monkeys were the only primate species actually observed eating human foods during the study.

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[30] This is known as 'topping' and encourages the development of suckers on the axils of the leaves which must be removed prior to harvesting (Yayock *et al.*, 1988). The process is believed to increase the tobacco's nicotine content (Geist, 1999).

Data from bush duiker (*Sylvicapra grimmia*)[31] may also include damage by bushbuck (*Tragelaphus scriptus*). When asked to identify the raiding species using pictures, field assistants and farmers repeatedly indicated that bush duiker was responsible for secondary evidence and subsequent crop damage. However, only bushbuck were observed in fields and their skins seen in the homes of local people.

Crop damage was measured by counting damaged stems and converting to $m^2$ using average planting densities (i.e. banana, maize, cassava) or measuring directly in $m^2$ for sown crops (i.e. millet, beans) (after Naughton-Treves, 1996). It is important to note that 'damage' does not necessarily mean complete loss; for example, the farmer may be able to retrieve some cobs when maize stems are trampled by bush pig. However, the yield will be significantly reduced. Furthermore, estimates of area lost are conservative for this study as not all planting densities are calculable either due to a limited number of fields planted with the crop or the nature of the crop type; it is difficult to assess the damage area of fruit as there is little consistency to yield on a branch. Loss to specific crops can also be very difficult to measure. For example, identifying the number of stems damaged in a chimpanzee raid on sugar cane is problematic as individuals will travel deep into the densely planted, seven foot high crop. In addition, stems can be bent and trampled in a raid but still harvestable.

During farm monitoring the presence of damage by other factors (e.g. weather, insects, termites and people) was also recorded. Insect damage was defined by the presence of holes or marks on the leaves or stem of the plant. Stem damage (whereby the stem of the plant was eaten from the inside) was so prevalent that it is recorded separately. Damage by people was identified in the same way as that for animal species, with two pieces of evidence including independent verification.

[31] The bush duiker is also known as the common or grey duiker (*Cephalophus sp*), however the *Silvicapra* taxonomic classification is used here (as per Kingdon, 1997) as this was the field guide used during the study.

*5.2.2 Goat Damage Study*

To ensure that goats pruned every plant in the three experimental conditions, the animals were walked slowly up and down each line of maize in the study plot. Any stem that the goat did not touch was pruned by hand.

The crop was harvested in late November 2005 and all cobs weighed and measured (length) using a spring balance and tape measure. To ensure accurate results, data for one hundred cobs from each condition (weekly pruning, monthly pruning and control) were randomly selected using number tables and used in data analysis.

*5.2.3 GIS Analysis*

A GIS was used to ascertain the relationship of key variables with the presence of crop raids. Farm vector and raid point data were digitized at a resolution of $812.25m^2$ (28.5m x 28.5m) and layered in a raster based system (Appendix 8 gives examples of the vector and point data used for one sample village). A raster system is a useful way of examining spatial data as the size and shape of each unit of analysis is consistent (Chou, 1997). The course resolution was selected to correspond with existing forest loss maps of the area and to ensure that there was no spatial autocorrelation (SA) between grid cells. As Segurado *et al* (2006) demonstrate, SA can overestimate the statistical significance of spatial relationships and increase the potential for type I errors; other studies of human-wildlife conflict have had to use relatively low resolution due to this issue (e.g. Sitati *et al.*, 2003). Its treatment can also significantly impact upon subsequent models and management practice (Stephenson *et al.*, 2006). In this study, Moran's I statistic was used to test for SA using Crimestats software v.3.0 (N.Levine & Associates, Houston, TX).

A sample of 1247 (Season 1), 1231 (Season 2) and 1222 (Season 3) grid cells was created and these were exported into SPSS for logistic regression analysis.

*5.2.4 Logistic Regression*

Raid presence or absence was used as a dichotomous dependent variable and key environmental factors tested for their significance (e.g. presence of specific crops). Presence/ absence data has been used to examine the significant effect of variables in other studies of human-wildlife conflict (e.g. Tourenq *et al.*, 2001, Sitati *et al.*, 2003). The distance function in ARCGIS was used to calculate the distance of each grid cell from other environmental factors, i.e. the forest edge[32] or fallow areas (after Sitati *et al.*, 2003, Kolowski and Holekamp, 2006, Stephenson *et al.*, 2006). Data were analysed using a backward binary logistic regression procedure. Entry and exit variables were defined by the Wald statistic with probabilities of 0.05 and 0.1 respectively.

To plot the probability of a raid occurring for each grid cell and produce risk maps, the estimated coefficients (B) from logistic regression were entered into the GIS using the following formula:

$$\text{Prob (raid)} = \frac{1}{1 + e^{-Z}}$$

where $e$ is the base of the natural logarithms (approx 2.718) and Z is the linear combination:

$$Z = B_0 + B_1X_1 + B_2X_2 + \ldots + B_pX_p$$

$B_0$ and $B_1$ are coefficients estimated from the data, X is the independent variable and $p$ is the number of independent variables (formula and description taken from Norusis, 1999).

[32] Distance from forest edge was calculated using forest, degraded forest and plantations as all constitute primary habitat for raiding species at this site.

## 5.3 Results

### *5.3.1 Crop Damage around Budongo Forest Reserve*

Farms around BFR are vulnerable to crop damage from a number of factors, including large vertebrates (e.g. primates and ungulates), insects, termites/ stemborers, birds, disease, weather, people and small vertebrates (e.g. rats and squirrels). As Figure 5.1 demonstrates, there is a statistical significance in the presence or absence of these factors ($\chi^2$=136.03, df=7, p<0.01). Eighty percent of farms (N=129) experience at least one raid by large vertebrates but this is not the most frequently observed cause of crop damage. Evidence for insect damage (including crickets, grasshoppers, worms and caterpillars) is found in 82.1% of farms.

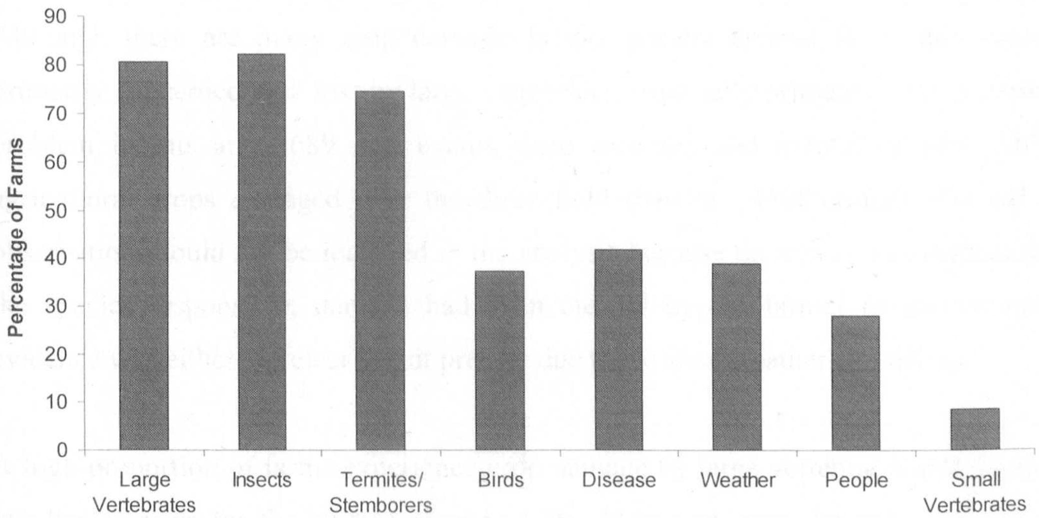



**Figure 5.1 Percentage of farms with the presence of different crop damage factors (N=129)**

Stem damage is also a common problem and is seen in 74.4% of farms. The majority of stem damage is seen in maize; the plant appears to grow normally but is being destroyed from the inside. As an elderly male farmer lamented, "you don't know there's a problem til the stem falls over". Local farmers ascribe the damage to termites, and indeed they were witnessed in the field (Figure 5.2), however, it could also be due to a type of stem borer such as *Busseola fusca* or *Chilo partellus* which can be particularly problematic to maize in the tropics.

Maize is not the only crop vulnerable to stem damage. Tobacco, sugar cane and sorghum are also affected. In addition, crop disease is found in 41.8% of farms. This includes the debilitating cassava mosaic, maize streak and banana wilt.

Evidence for crop damage caused by extreme weather is a feature of 38.7% of farms and includes hailstones, strong winds, flooding and drought. Perhaps the most surprising damage is due to people; 27.9% of farms experience crop loss as a result of careless weeding, out of control fires, children playing and flattening by vehicles. 'People raids' on sugar cane fields are also frequently observed (Figure 5.3).

*5.3.2 Crop Damage by Large Vertebrates*

Although there are many crop damage factors present around BFR, this study is primarily concerned with loss by large vertebrates, especially primates. It is a common problem in this area; 689 raid events were recorded and a total of 6093.7m$^2$ of agricultural crops damaged over the three field seasons. Furthermore, 336 *ad hoc* observations could not be included in the analysis because there was no evidence as to the species responsible; damage had been cleared by the farmer or the secondary evidence was either not clear or not present due to extreme weather conditions.

A high proportion of farms experience crop damage by large vertebrates and the mean number of raids for the study period is 4.58. However, crop damage is not evenly distributed across the sample:

**Table 5.1 Mean number of raids, area damaged (m$^2$) and percentage damaged (%) by large vertebrates per farm and village (N=129) over the three seasons**

| *Level of Analysis* | *Mean Number of Raids* | *Mean Area Damaged (m$^2$)* | *Mean Percentage Damaged (%)* |
|---|---|---|---|
| Individual Farm | 4.58±6.27 | 47.24±70.8 | 1.94% ±7.6 |
| Village | | | |
| Kyempunu | 6.11±7.26 | 29.03±35.04 | 1.16±2.01 |
| Nyabyeya II | 7.85±8.56 | 56.35±81.92 | 0.84±1.12 |
| Fundudolo | 4.24±5.61 | 50.79±77.65 | 1.11±1.75 |
| Nyakafunjo | 4.58±4.28 | 45.88±68.51 | 3.76±13.02 |

**Figure 5.2 Photograph depicting termite damage to maize stem**

**Figure 5.3 Photograph depicting children eating sugar cane on their way home from school**

The majority of farms (n=82) have between one and ten damage events but a small number (n=7) experience twenty-one or more (Figure 5.4a). As Figure 5.4b demonstrates, the total area damaged also varies; 65 farms have between 0.1 and 50m$^2$ damaged but 7 lose more than 200m$^2$ to large vertebrates. There is a significant positive correlation between the number of damage events experienced and the area damaged by farm (Spearman rho=0.820, N=129, $p<0.01$).

Whilst it is clear that the majority of farms experience low levels of crop damage by large vertebrates, a small proportion are greatly affected; 11 farmers lost over 3.1% of their potential cultivable land area during this study (Figure 5.4c). There is no statistical difference in the presence of damage and wealth (chi-square), which indicates that all wealth levels are equally affected by crop raiding, however this does not reflect people's ability to cope with crop damage.

*5.3.3 Damage to Specific Crop Types*

Large vertebrates eat at least seventeen different types of food crops/ fruit trees around BFR. However, as Table 5.2 indicates, not all crops are damaged in equal measure; 45.1% of all raid events and almost half of the total area lost is maize (N=689 and 6093m$^2$). Twenty three percent of all damage events are to cassava but only 16% of the total area damaged is cassava. Maize and cassava are also the most frequently grown crops in this area.

Banana is the third most commonly grown foodstuff and it receives a high number of raids (n=51). However, it is only ranked 8$^{th}$ in total area lost to crop damage. In contrast, sweet potato is grown in few farms and yet it experiences many damage events (n=43) and the second highest area lost to crop damage by large vertebrates (1028.41m$^2$).

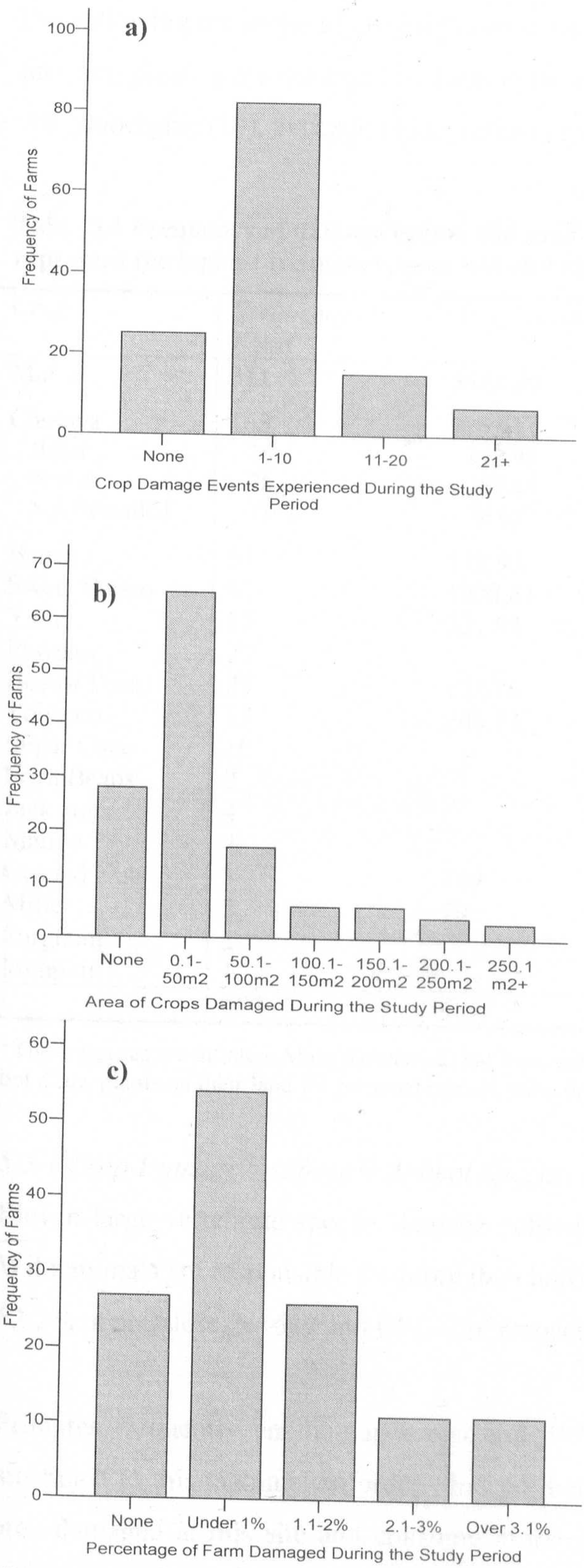



**Figure 5.4 (a) Number of damage events, (b) area of crops damaged in $m^2$ and (c) percentage of farm damaged by large vertebrates over the 3 field seasons (N=129)**

The following are in the top twenty most commonly grown crop types around the study sites and yet they are not eaten by large animals (grown rank in parenthesis) - pineapple (10), aubergine (14), avocado (16), coffee (17), okra (18) and chilli (19).

**Table 5.2 Frequency of damage events and area damaged by crop type (bold figures represent the highest frequency, area lost and rank)**

| *Crop* | *Frequency of Raids* | *Area Lost($m^2$)* | *Frequency Grown (rank)* |
|---|---|---|---|
| Maize | **311** | **3022.39** | 2 |
| Cassava | 165 | 976.61 | **1** |
| Bitter | 76 | 412.93 | |
| Sweet | 78 | 487.01 | |
| Not Recorded | 11 | 76.67 | |
| Banana | 51 | 130.95 | 3* |
| Sweet Potato | 43 | 1028.41 | 9 |
| Yam | 27 | 327.94 | 4 |
| Pawpaw | 21 | | 6 |
| Beans/ Peas | 23 | 172.76 | 8 |
| Tobacco | 15 | 206.74 | 13 |
| Sugar Cane | 10 | | 11* |
| Soya Beans | 7 | | 26 |
| Jackfruit | 4 | | 7 |
| Mango | 4 | | 5 |
| Ground Nuts | 3 | 149 | 22 |
| Millet | 2 | 79 | 23 |
| Sorghum | 2 | | 16 |
| Pumpkin | 1 | | 12 |
| | *689* | *6093.7* | |

*These figures are inflated. Many farmers do not have entire fields of sugar cane or banana plantations but a few plants on their land for personal consumption or sale in local markets.

### *5.3.4 Crop Damage by Specific Animal Species*

Eleven large vertebrate species damage cultivated crops at the study site (Table 5.3). Wild animals are responsible for more than half of all recorded damage events and over 62.2% of area lost (N=689 and 6093.7$m^2$ respectively).

Primates frequently eat human crops and 40% of all damage events (N=689) are attributed to this mammalian order. Indeed, baboons are responsible for 33.8% of the area damaged at this site and consume more crop types than any other wild species (n=13). Monkeys also raid often (n=92) but only 212.1m$^2$ of damage is due to these animals. Damage by chimpanzees, however, is rarely recorded.

**Table 5.3 Frequency of damage events and area damaged by animal species (bold figures indicate the highest rank for that category)**

| *Crop Raiding Species* | *Latin Name* | *Raids (Freq)* | *Area Damaged (m$^2$)* | *Number of Crop Types Damaged* |
|---|---|---|---|---|
| *Wild* | | *394* | *3791.36* | |
| Bush Duiker | *Sylvicapra grimmia* | 35 | 353.5 | 5 |
| Monkey | *Cercopithecus & Colobus sp.* | 92 | 212.1 | 3 |
| Baboon | *Papio anubis* | 164 | **2059.5** | **13** |
| Chimpanzee | *Pan troglodytes schweinfurthii* | 13 | 8.9 | 6 |
| Bush Pig | *Potamochoerus sp.*[33] | 83 | 1006.8 | 4 |
| Buffalo | *Syncerus caffer* | 4 | 137.36 | 4 |
| Porcupine | *Hystrix cristata* | 3 | 13.2 | 2 |
| *Domestic* | | *282* | *2033.6* | |
| Goat | *Capra hircus* | **250** | 1664.6 | 10 |
| Domestic Pig | *Sus scrofa* | 19 | 123.8 | 6 |
| Cow | *Bos taurus* | 12 | 244.5 | 5 |
| Sheep | *Ovis aries* | 1 | 0.7 | 1 |
| Pig* | | 13 | 269 | 4 |
| **Total** | | 689 | 6093.7 | 19 |

* Secondary evidence at the raiding site confirmed the animal responsible to be pig; however, in these cases it was not possible to determine whether it was a wild or domestic species

Ungulates cause significant amounts of crop damage; 12% of all raids and 16.5% of the total area lost is attributed to bush pig. Domestic species are responsible for 40.9% of all damage events in this area, with goats causing the largest proportion of this loss. They eat ten different crop types, are responsible for 36.3% of crop raids and 1664.6m$^2$ of actual damage. Other domestic animals (pig, cow and sheep) cause only 32 raids and 6.05% of total area damaged over the study.

There is a significant distribution in the maturity of crops damaged by animals when grouped into wild and domestic species ($\chi^2$=78.456, df=1, $p<0.01$). Ninety four percent (N=282) of all raid events by domestic livestock are on immature crops (Figure 5.5).

[33] Previous studies refer to the presence of *P.porcus* in this area (Hill, 1997, Tweheyo *et al.*, 2005) although the IUCN action plan suggests it should be *P. larvatus* at the edge of its range (Vercammen *et al.*, 1993). It is not possible to verify the taxonomy of this species as no bush pig were observed during the study.

In contrast, over one third of damage events by wild animals are on mature crops (N=394). All animals consume immature crops more frequently than mature and for some species this is particularly evident; 97.6% of goat raids (N=250) and 74.3% of baboon raids (N=164) are upon immature foodstuffs. For monkey and bush pig, however, the difference between damage on immature and mature crops is small (8.6%, N=92 and 1.2%, N=83 respectively).

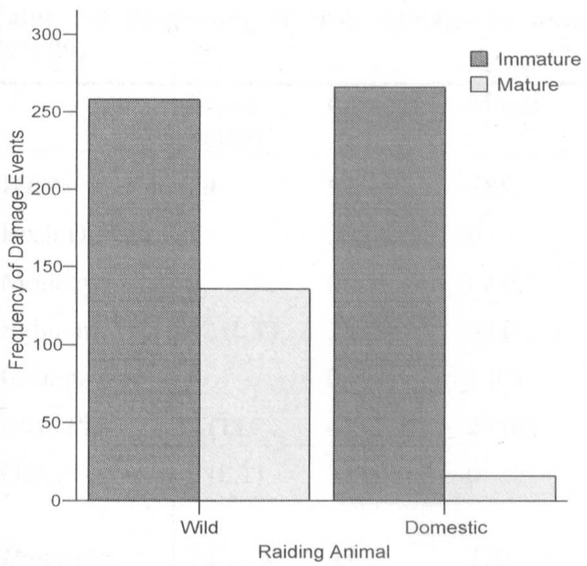



**Figure 5.5 Maturity of crop damaged by wild and domestic species (N=676)**

There is also a significant difference in damage events by wild and domestic species by crop type ($\chi^2$=21.578, df=6, p<0.01) – Table 5.4.

Wild species are responsible for 88% of all damage to cash crops in this area (N=25). Sixty percent of all maize raids (N=305) and fruit raids (N=78) are also by wild species (when 'pig' is removed from analysis). In contrast, domestic animals eat a higher proportion of yam (70.3%, N=27) and sweet potato leaves (52.3%, N=42). Although it is not possible to analyse statistically due to small sample size (chi-square), some species appear to target specific crops.

Goats eat every category of crop type. Baboons also damage a high number of different crop types but predominately maize, cassava and cash crops (i.e. tobacco). Additionally, local people report that baboons take chickens although this was not observed during the study. Other species appear more specific in their crop choices; for example, monkeys consume a high level of cultivated fruit and maize, and bush pig eat mainly cassava and maize.

**Table 5.4 Frequency of crop damage by animal species, crop type and plant part* (N=689)**

| | Sweet Potato | Cassava | Maize | Fruit | Cash Crops | Yam | Other | Total |
|---|---|---|---|---|---|---|---|---|
| ***Wild*** | ***20*** | ***92*** | ***185*** | ***47*** | ***22*** | ***8*** | ***20*** | ***394*** |
| Bush Duiker | 4 | 25(L) | 0 | 0 | 0 | 0 | 5 (L) | 34 |
| Monkey | 0 | 0 | 62 (C) | 30 (FR) | 0 | 0 | 0 | 92 |
| Baboon | 12 (L,T) | 20 (T) | 93 (L,C) | 9 (FR) | 18 (L) | 0 | 12 (L) | 164 |
| Chimpanzee | 0 | 0 | 1 (C) | 8 (FR) | 4 | 0 | 0 | 13 |
| Bush Pig | 2 (T) | 44 (T) | 29 (C) | 0 | 0 | 8 (T) | 0 | 83 |
| Other | 2 (L,T) | 3 (T) | 0 | 0 | 0 | 0 | 3 (L) | 8 |
| ***Domestic*** | ***22*** | ***69*** | ***120*** | ***31*** | ***3*** | ***19*** | ***18*** | ***282*** |
| Goat | 17 (L) | 61 (L) | 117 (L,C) | 28 (L) | 3 (L) | 8 (L) | 16 (L) | 250 |
| Other | 5 (L,T) | 8 (L,T) | 3 (L) | 3 | 0 | 11 (L) | 2 (L) | 32 |
| Pig | 1 (T) | 4 (T) | 6 (C) | 2 (L) | 0 | 0 | 0 | 13 |
| **Total** | 43 | 165 | 311 | 80 | 25 | 27 | 38 | 689 |
| *(No pig)* | *42* | *161* | *305* | *78* | *25* | *27* | *38* | *676* |

* L = leaves, C = cob, T = tuber, FR = fruit, Blank = other i.e. stem, pod or a combination of parts

There is a significant difference in the distribution of damaged plant part when grouped by wild and domestic animals ($\chi^2$=430.309, df=5, p<0.01). Ninety four percent of all raids by domestic species (N=282) target the leaves of the crop. Wild animal damage is more variable with regard to plant part; 40.8% of damage events were on maize cobs and 23% on tubers (N=394). Goats eat mainly leaves and bush pig cobs and tubers. However, baboons appear less selective and consume all crop parts.

*5.3.5 Influence of Goat Damage on Maize Yield*

It is clear that domestic animals, in particular goats, cause significant damage to crops around BFR and the goat damage study reveals a difference in the weight and length of cobs as a factor of controlled pruning by these animals (Table 5.5). Cobs from plants damaged on a weekly basis are half the length and 26% lighter than the control group.

**Table 5.5. Impact of controlled goat damage on maize cob length and weight (N=300)**

| | *Pruned Once A Week* | *Pruned Once A Month* | *Control (No Damage)* |
|---|---|---|---|
| Mean Cob Length (cm) | 8.71±2.08 | 13.04±2.11 | 18.41±3.24 |
| Range (cm) | 5.08-20.32 | 10.16-16.51 | 12.7-24.13 |
| | | | |
| Mean Cob Weight (g) | 174.3±32.9 | 214.5±12.9 | 238.4±28.4 |
| Range (g) | 80-220 | 190-240 | 190-300 |

When divided further, the variation in cob length is clearly seen; only those on plants pruned once a week are less than 10cm. In contrast, the majority of cobs above 20.1cm (93%, N=43) are from the control group:

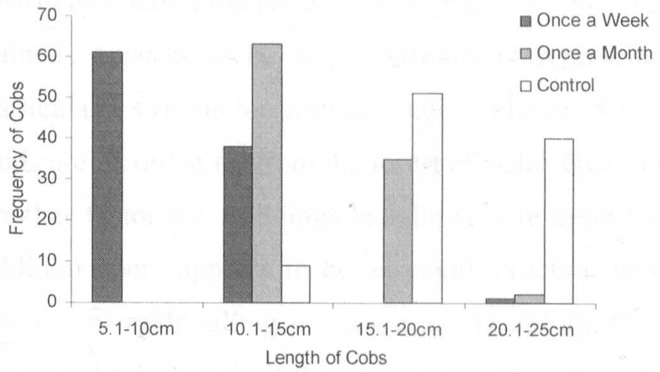



**Figure 5.6 Variation in maize cob length due to controlled pruning by goats (N=300)**

This variation was also seen in cob weight (Figure 5.7). Only plants pruned by goats on a weekly basis produced cobs of under 150g. However, plants that were not damaged throughout the experiment were the only group to produce cobs of between 251 and 300g.

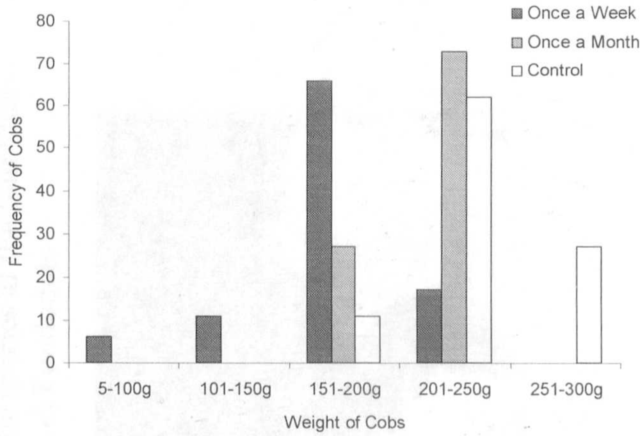



**Figure 5.7 Variation in maize cob weight due to controlled pruning by goats (N=300)**

There is a significant statistical difference in cob length (Kruskal Wallis=224.912, df=2, $p<0.01$) and cob weight (Kruskal Wallis=132.44, df=2, $p<0.01$) across the three conditions. Pruned maize is proportionally smaller and lighter than that of the control group.

*5.3.6 Identifying Environmental Variables that Impact upon Vulnerability to Crop Loss*

Examination of the GIS maps of damage events indicate that raids are not evenly distributed across the study sample (Figures 5.8-5.10). For example, damage by wild animals appears to be disproportionately represented at the forest edge. This is particularly striking for primate species (Figures 5.11-5.13). In contrast, most domestic raids are recorded far from the forest and clustered in the centre of fields. Proximity to another factor e.g. buildings or fallow, may impact upon raids by these animals. In addition, there appears to be temporal variation between the study seasons with the number of raids falling in season 3. Therefore, the following five key variables are examined to ascertain if they have a significant relationship with presence/ absence of raid events:

- Seasonality
- Crops grown (those most damaged i.e. maize, cassava and sweet potato)
- Distance from forest
- Distance from fallow
- Building presence

**Figure 5.8 Maps showing the location of crop damage by wild and domestic species at the four study sites during Season 1 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo**

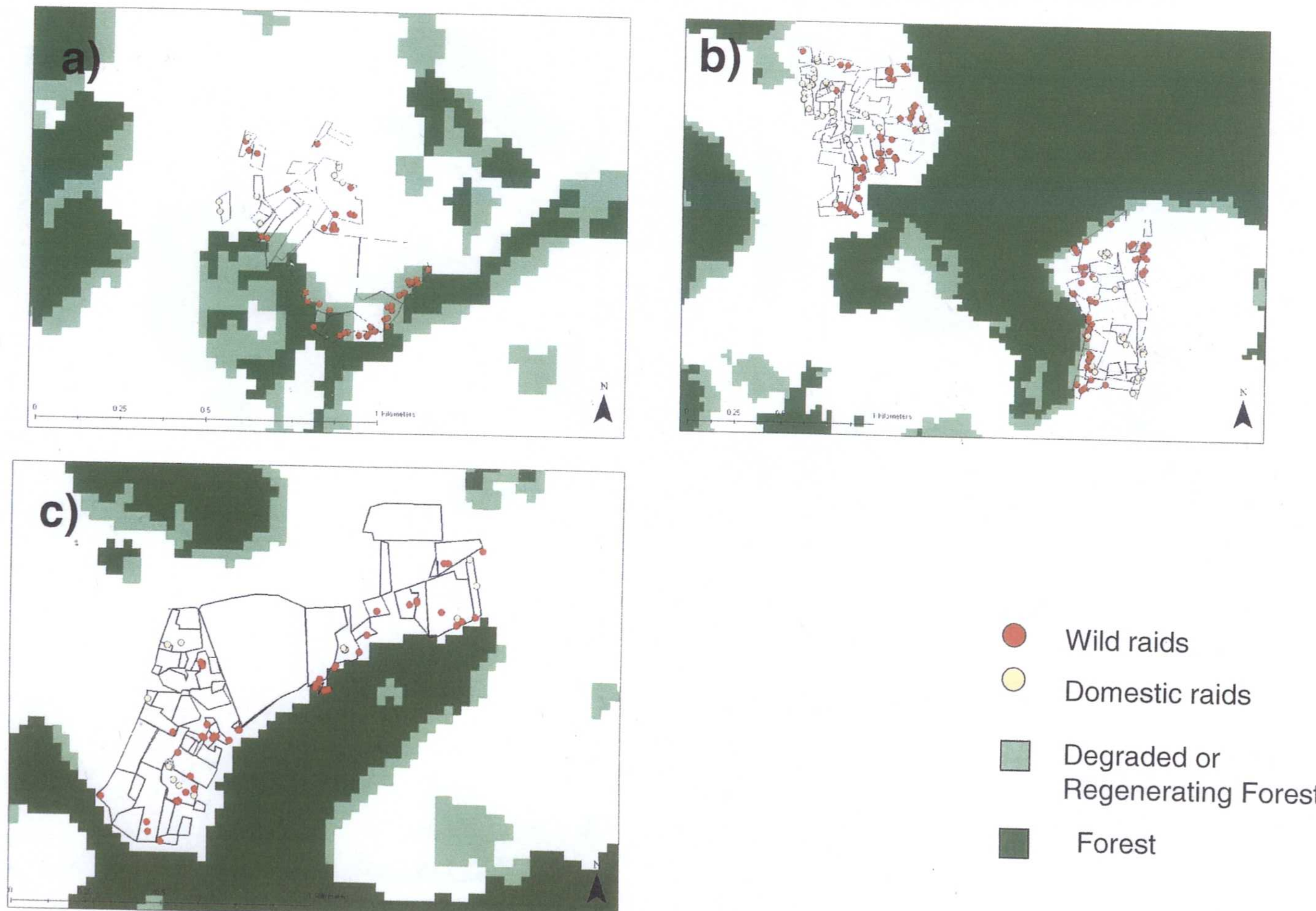


Figure 5.9 Maps showing the location of crop damage by wild and domestic species at the four study sites during Season 2 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo

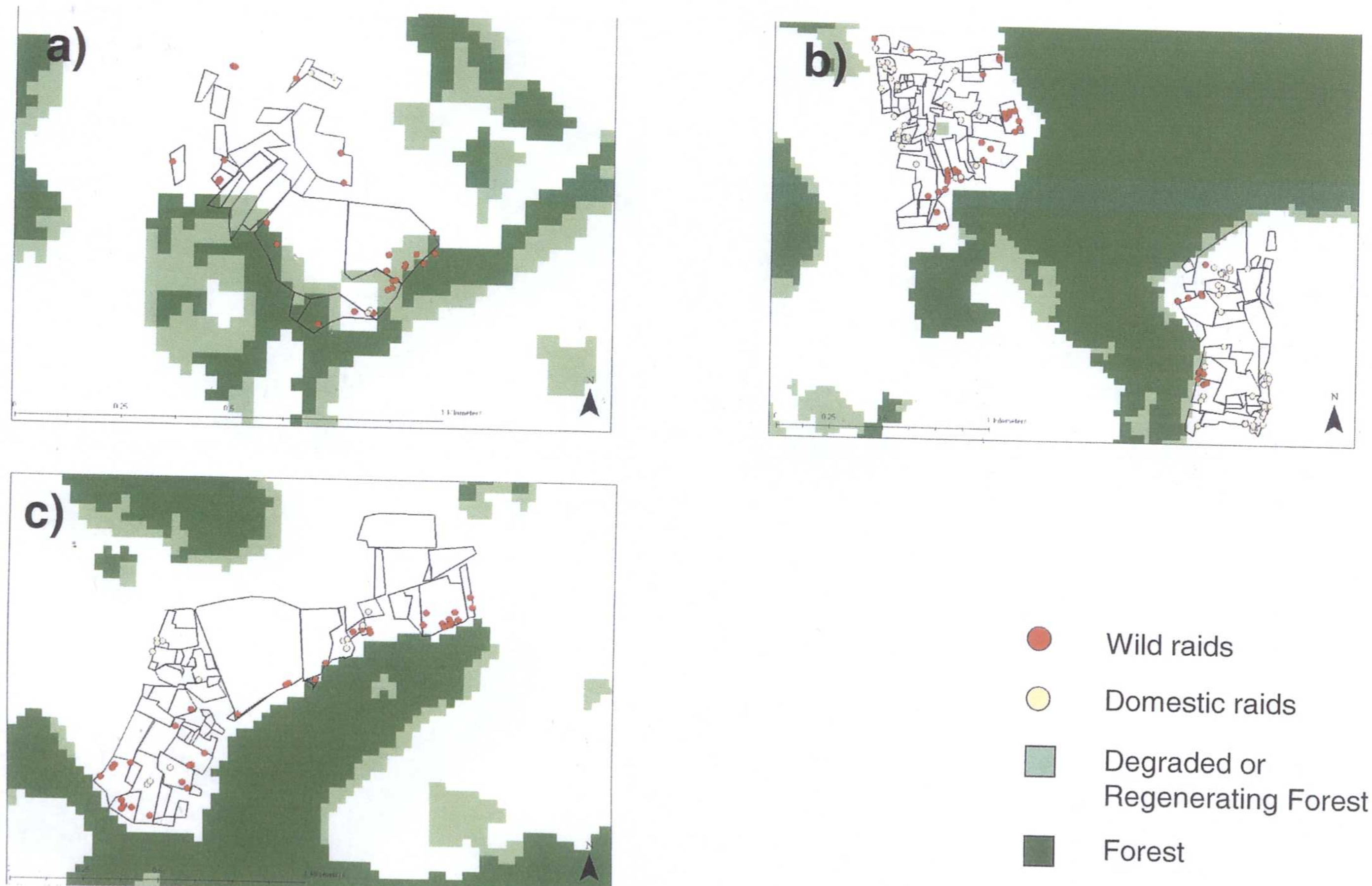


Figure 5.10 Maps showing the location of crop damage by wild and domestic species at the four study sites during Season 3 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo

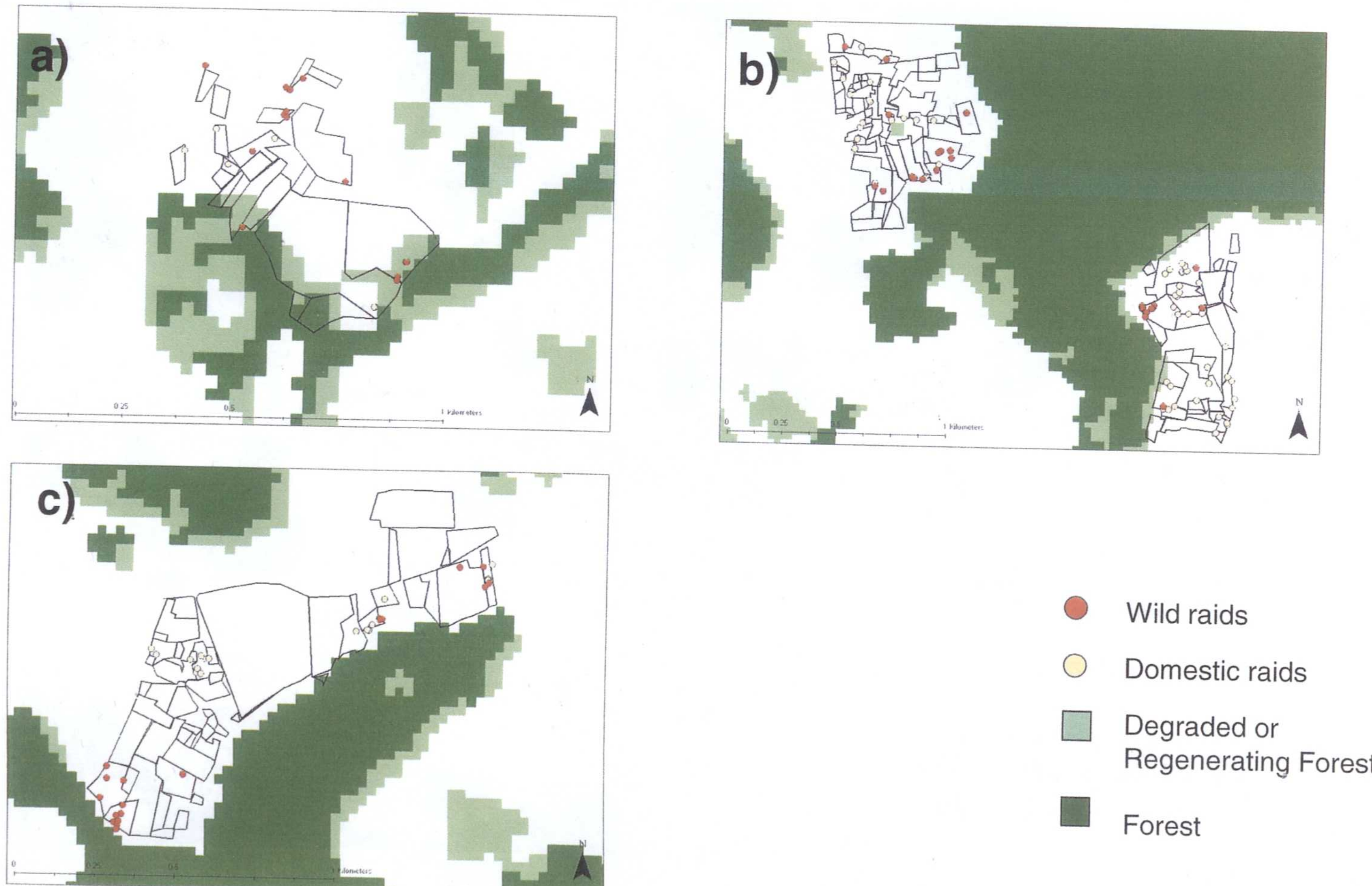


**Figure 5.11 Maps showing the location of crop damage by primates and other wild species at the four study sites during Season 1 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo**

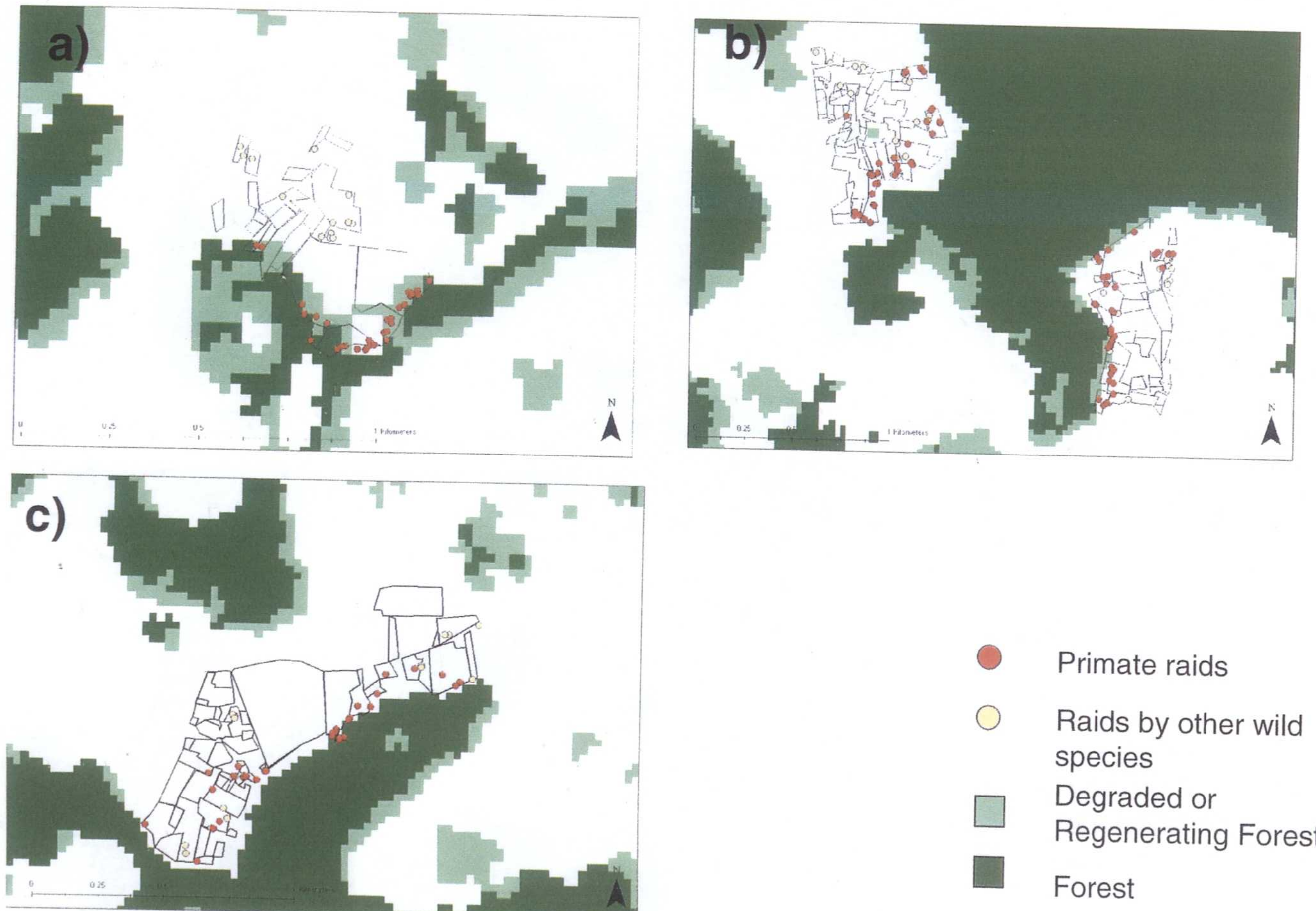


**Figure 5.12 Maps showing the location of crop damage by primates and other wild species at the four study sites during Season 2 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo**

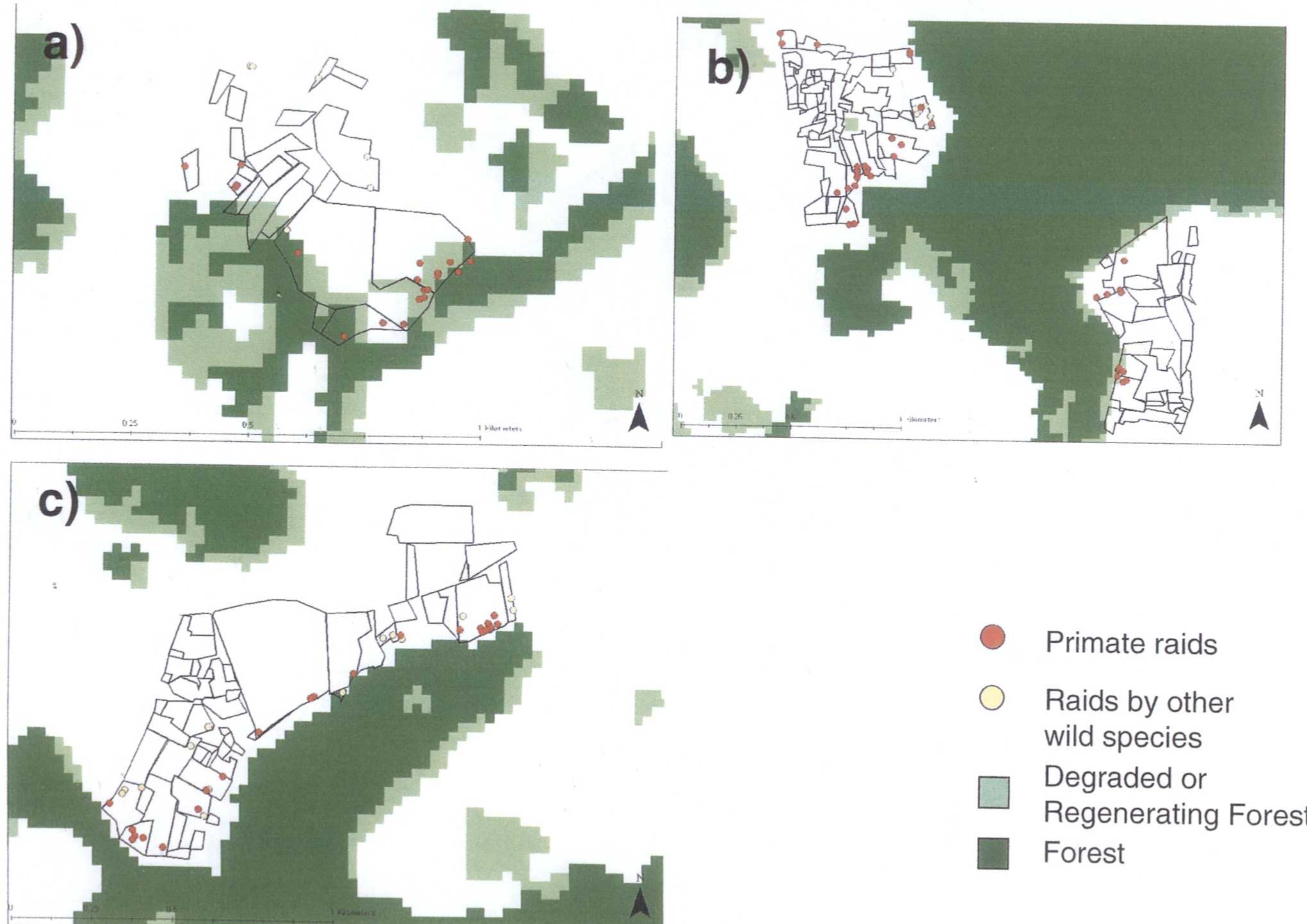
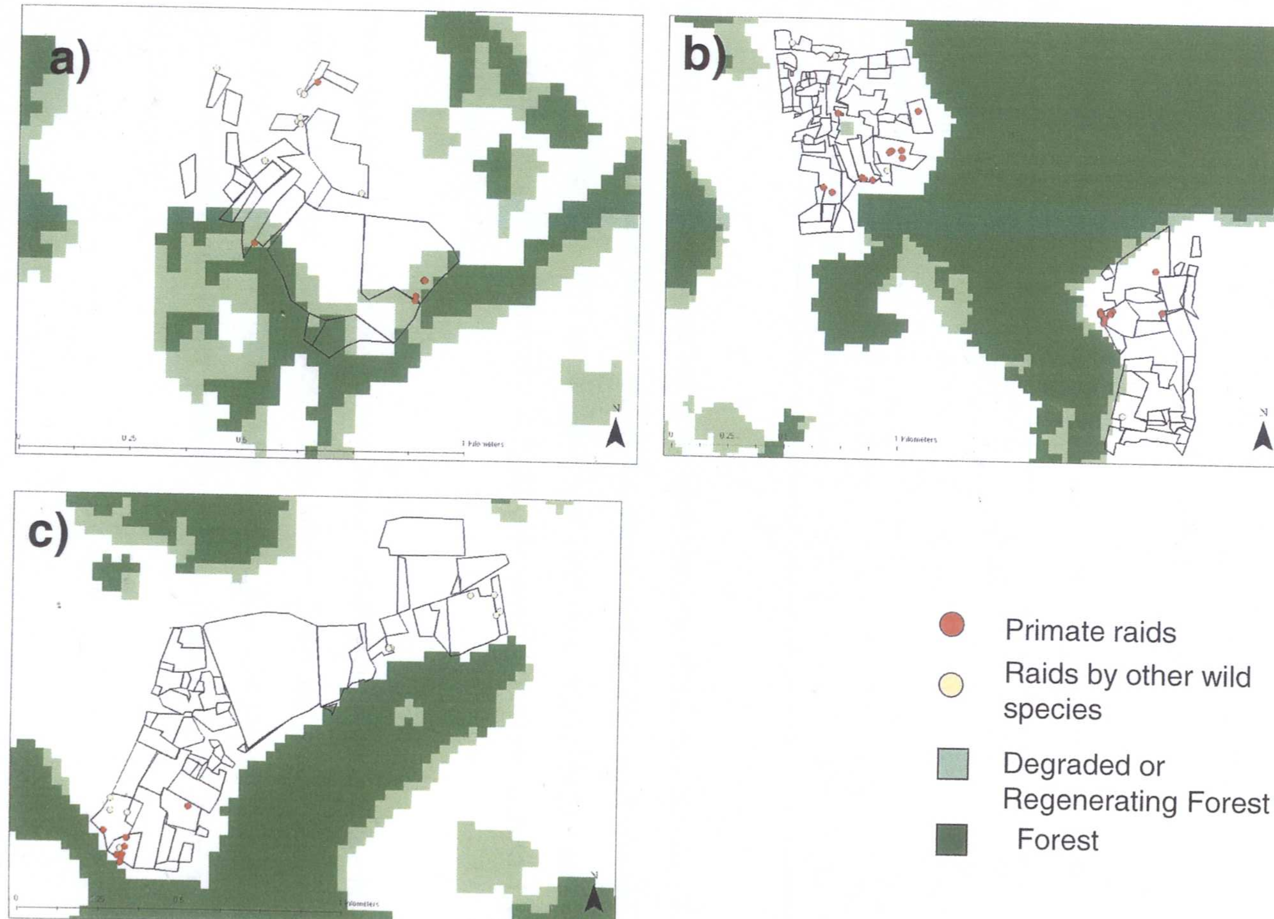


**Figure 5.13 Maps showing the location of crop damage by primates and other wild species at the four study sites during Season 3 (a) Kyempunu, b) Nyakafunjo and Nyabyeya II and c) Fundudolo**



5.3.6.1 Seasonality

The total number of raids and area damaged reduce significantly over the three study seasons ($\chi^2$=54.28, df=2, p<0.01 and $\chi^2$=343.7, df=2, p<0.01 respectively). Analysis of the unstandardized residuals reveals that season 1 has more damage events and area lost than would be expected (+83.4 and +449 respectively).

**Table 5.6 Number of raids and area damaged ($m^2$) by large vertebrates across the study seasons**

| | *Season 1* | *Season 2* | *Season 3* | *Total* |
|---|---|---|---|---|
| Total Number of Raids | 313 | 220 | 156 | 689 |
| Total Area lost ($m^2$) | 2480.2 | 2251.7 | 1361.8 | 6093.7 |
| Mean Number of Raids per farm | 2.4±3.1 | 1.7±2.4 | 1.2±2.1 | 4.5±6.2 |
| Mean Area Damaged per farm ($m^2$) | 19.2±34.5 | 17.4±37.9 | 10.5±28.4 | 47.2±70.8 |
| Mean Percentage Lost per farm | 0.6±1.5 | 1.04±7.2 | 0.2±1.4 | 1.9±7.6 |

Although one would expect some temporal variation, the difference between Season 1 and Season 2 is surprising as they are at the same time of year (end March/April to July). However, when the data are divided into mean monthly raids and area lost it is clear that whilst there is a difference in totals, the distribution for Season 1 and 2 is very similar (Figure 5.14).

There is no significant association between mean monthly rainfall and the number of raids / area lost to large vertebrates, when analysed for the study season periods (Spearman rho). However, as Figure 5.14 indicates, peaks in the number of raids and area lost occur several months after peaks in rainfall (Season 1 and 2) or are closely associated (Season 3).

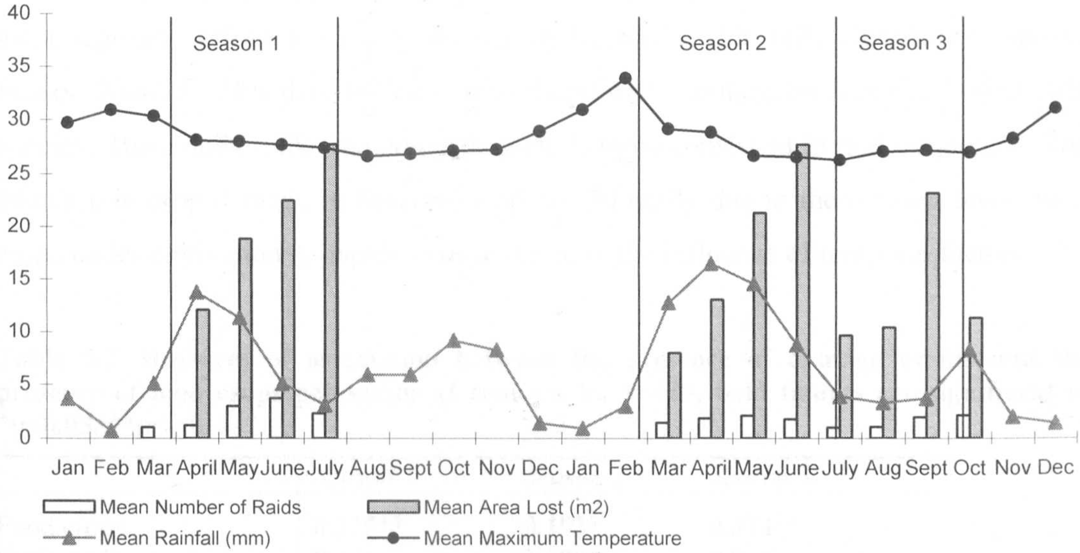



**Figure 5.14 Mean number of raids and area damaged ($m^2$) by large vertebrates compared with rainfall (mm) and maximum temperature over the three study seasons (2004 and 2005)**

The distribution of raids is also significantly different across the three study seasons ($\chi^2$=44.995, df=2, p<0.01). Damage events by wild animals fell in number from Season 1 to 3 whereas those by domestic species remained constant.

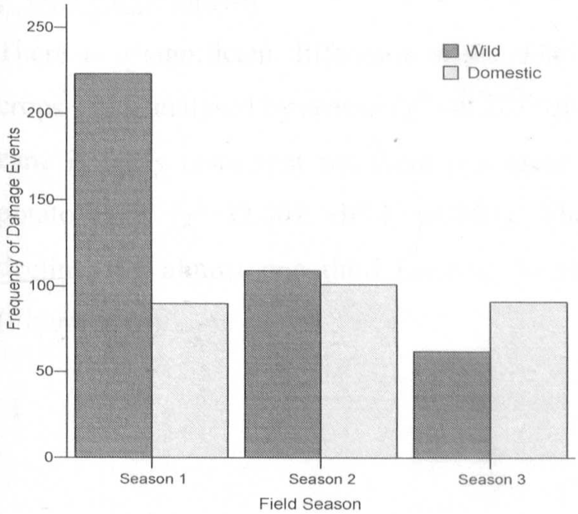



**Figure 5.15 Damage events by domestic and wild species across the study seasons (N=676)**

Crop raids by specific species also demonstrates temporal variation; whilst baboons most regularly utilize human foods during Season 1, this falls significantly during Season 2 and 3. This distribution is also found with monkey, bush pig and other wild species. Bush duiker, like the domestic goat, is more consistent in raid frequency. The decrease in crop damage in Season 3 appears primarily due to there being fewer food crops under cultivation (Chapter 4) as opposed to the influence of temporal factors:

**Table 5.7 Measures of association between the presence of damage events and the presence of food crops per season (Cramer's V, N=129, bold figures are significant at *p<0.05, **p<0.01)**

| | *Season 1* | *Season 2* | *Season 3* |
|---|---|---|---|
| Food crops | **0.225**** | **0.193*** | **0.374**** |
| Cash crops | 0.121 | **0.198*** | 0.035 |

The presence of damage events is significantly associated with the presence of food crops in the farm for all seasons. The presence of cash crops is only significant in Season 2. It is important, therefore to examine specific crops in order to understand their influence upon the presence of crop raids per season.

5.3.6.2 Crops Grown

There is a significant difference in the distribution of the most frequently damaged crops when analysed by season ($\chi^2$=49.201, df=12, p<0.01): loss to fruit, yam and sugar cane is fairly consistent but there is a clear difference in maize, cassava and sweet potato raids ($\chi^2$=32.407, df=4, p<0.01). The number of damage events to maize declines by almost one third (30.8%, N=311) throughout the three study seasons (Figure 5.16).

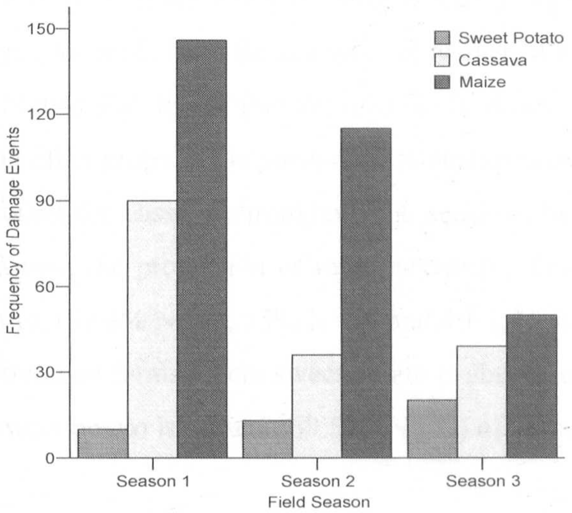



**Figure 5.16 Damage events to maize, cassava and sweet potato by season (N=519)**

Cassava damage also falls from Season 1 to 2 but increases slightly in Season 3. In contrast, sweet potato raids double from Season 1 (n=10) to Season 3 (n=20). There is a significant association between the presence of damage events and whether maize, cassava or sweet potato is present in the farm; however this relationship is strongest for maize:

**Table 5.8 Measures of association between the presence of damage events by wild/domestic species and the presence of maize, cassava and sweet potato per season (Cramer's V, N=129, bold figures are significant at * p<0.05, **p<0.01)**

| | *Maize* | *Cassava* | *Sweet Potato* |
|---|---|---|---|
| *Season 1* | **0.279**** | 0.137 | 0.173 |
| Domestic | 0.140 | 0.162 | 0.027 |
| Wild | **0.265**** | 0.118 | **0.246**** |
| *Season 2* | **0.430**** | 0.152 | **0.222*** |
| Domestic | **0.309**** | 0.138 | **0.215*** |
| Wild | **0.216*** | 0.136 | 0.130 |
| *Season 3* | **0.464**** | **0.375**** | **0.276**** |
| Domestic | **0.280**** | **0.294**** | 0.167 |
| Wild | **0.387**** | **0.292**** | **0.268**** |

Damage is more likely to occur if maize is present in the farm and this is particularly true for raids by wild animals. However, it should be noted that 29.1% (N=72), 25% (N=64) and 46.9% (N=49) of raids in maize farms during the three study seasons are on other crops. This positive relationship between raid presence and crop grown is also found for cassava throughout the seasons; however it is only significant in season 3. Again, the proportion of raids in cassava farms that take place on other crops is also high (37.3% N=67; 55% N=54 and 40%, N=47). In contrast, raids are more frequently found on farms where sweet potato is absent, except for Season 3. Even in fields where sweet potato is present, 69.5% (N=23) of damage events are to other crops.

5.3.6.3 Distance from Forest

Grid cells from GIS mapping are used to examine the significance of forest proximity as this is a much finer level of analysis and will detect subtle variations in the presence of damage events.

**Table 5.9 Differences between the presence of damage events and distance from forest by season (chi-square). N, the total number of grid cells containing raids, is in parenthesis*. Results in bold italics are not significant, all other results are statistically significant to $p<0.01$.**

| | *Season 1* | *Season 2* | *Season 3* |
|---|---|---|---|
| All raids | 54.006 (157) | 48.819 (155) | 18.654 (81) |
| Wild raids | 73.133 (113) | 52.532 (111) | **9.6 (35)** |
| Domestic raids | 26.547 (53) | 43.070 (57) | 32.261 (46) |

* The sum of cells for wild and domestic species does not always equal the same as all raids as some cells experienced damage by both categories of animal

The presence of damage events is significantly different in grid cells at varying distance from forest or plantations (1-25m, 26-50m...201m+) apart from wild raids in season 3. Damage by wild species is generally found closer to wild animal habitat, as the GIS maps (Figures 5.8-5.10) verify. Indeed, few wild raids are more than 250m from the forest edge (Season 1 = 4, Season 2 = 4, Season 3 = 2). There is a small peak in the number of wild raids over 201m from the forest edge that is more noticeable in season 1 and 2 (Figure 5.17).

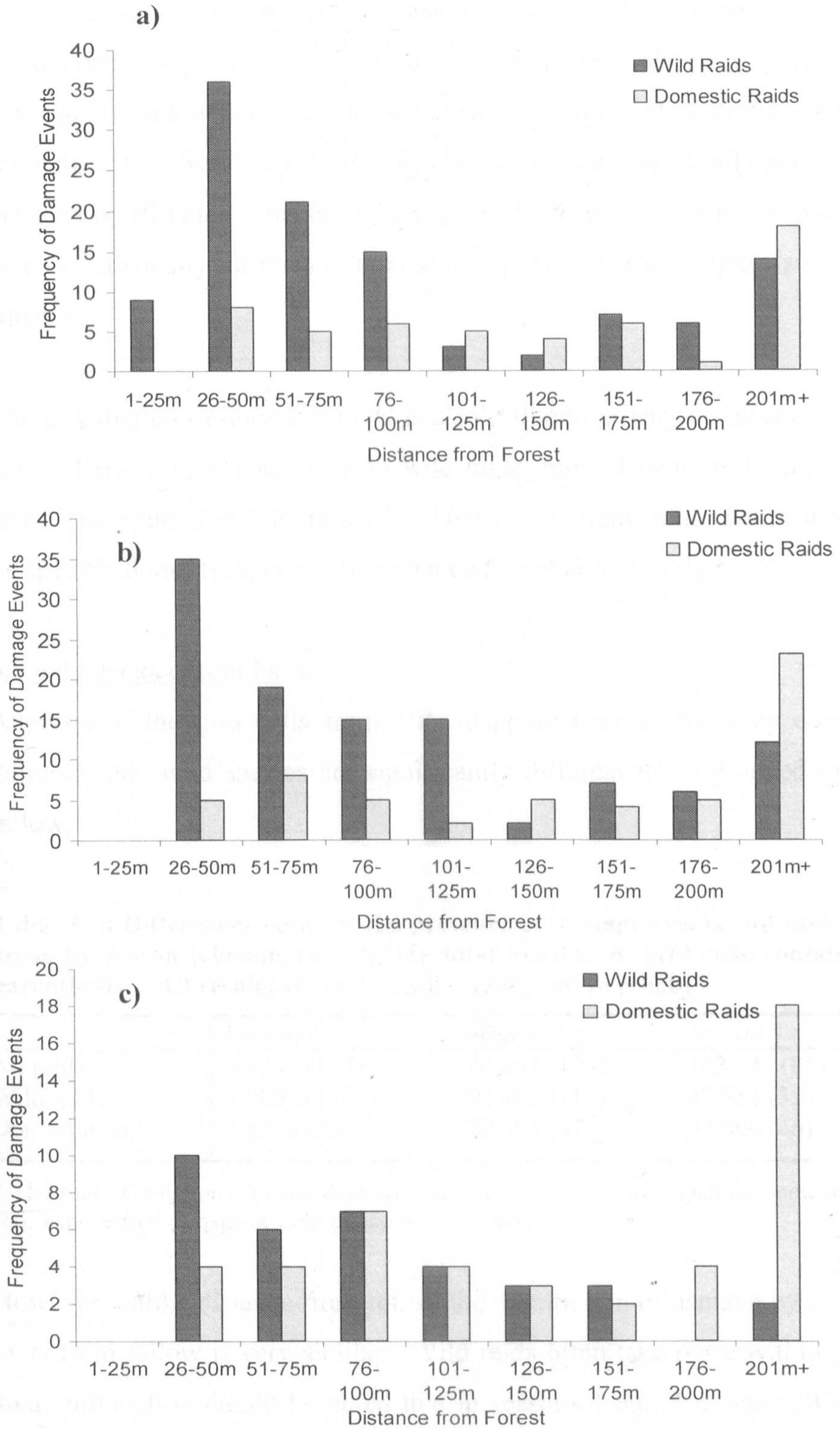



**Figure 5.17 Damage events by wild and domestic species at varying distances from the forest during a) season 1, b) season 2 and c) season 3**

This peak may be due to raids by specific species. When examined at the farm level, the majority of monkey ($\chi^2$=19.8, df=2, p<0.01) and baboon ($\chi^2$=27.37, df=2, p<0.01) damage is found within 250m from forest/ plantation (100%, N=92 and 97.3%, N=164) respectively). Raids by bush pig, however, are not significantly different when grouped by distance from the forest edge. Unfortunately it is not possible to analyse results statistically for bush duiker or chimpanzee as the sample size is too small (chi-square).

The distribution of domestic raids is also different at varying distances from the forest edge. However, in contrast with wild raids, most damage is found over 201m from forest and plantation (Figure 5.17). There is no significant relationship between raids by specific domestic species and distance from the forest edge.

5.3.6.4 Distance from Fallow

Analysis of the grid cells from GIS mapping reveals that crop damage events for domestic and wild species are significantly different when grouped by distance from fallow:

**Table 5.10 Differences between the presence of damage events and distance from fallow areas by season (chi-square). N, the total number of grid cells containing raids, is in parenthesis*. All results are statistically significant to p<0.01.**

| | *Season 1* | *Season 2* | *Season 3* |
|---|---|---|---|
| All raids | 96.261 (157). | 94.097 (155) | 123.543 (81) |
| Wild raids | 128.035 (113) | 93.162 (111) | 47.514 (35) |
| Domestic raids | 20.698 (53) | 70.596 (57) | 54.696 (46) |

* The sum of cells for wild and domestic species does not always equal the same as all raids as some cells experienced damage by both categories of animal

However, unlike distance from forest, the distribution of damage by wild and domestic raids from fallow is very similar. Wild raids often take place within 50m of a fallow area, although it should be noted that in seasons 1 and 2 at least 20 raids were more than 201m from this land use category (Figure 5.18).

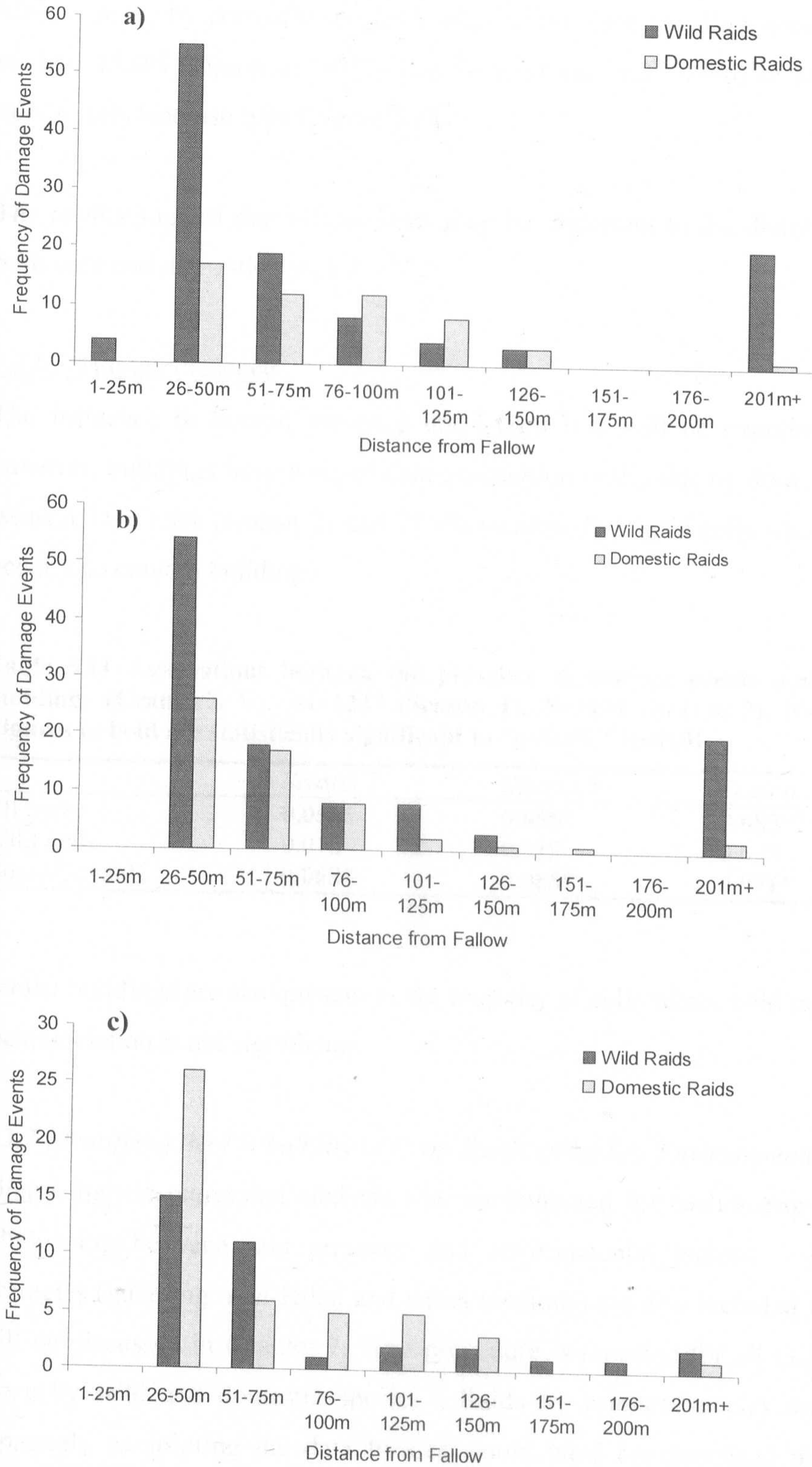



**Figure 5.18 Damage events by wild and domestic species at varying distances from fallow areas during a) season 1, b) season 2 and c) season 3**

Most damage by domestic species is also found close to fallow areas; 32% (season 1, N=53), 45.6% (season 2, N=57) and 56.5% (season 3, N=46) of all raids are within 50m of this land use type (Figure 5.18).

The results suggest that fallow areas may be important to the distribution of raids by both wild and domestic species.

#### 5.3.6.5 Human Presence

The influence of human presence upon crop loss will be examined in Chapter 7, however, buildings have a significant association with raids by domestic species; 76% (season 1), 73.5% (season 2) and 77.1% (season 3) of grid cells where domestic raids occur also contain buildings:

**Table 5.11 Associations between the presence of damage events and the presence of buildings (Cramer's V). N=1247 (Season 1), N=1231 (Season 2), N=1222 (Season 3). Figures in bold are statistically significant to *p<0.05, **p<0.01.**

| | *Season 1* | *Season 2* | *Season 3* |
|---|---|---|---|
| All raids | **0.056*** | **0.058*** | **0.085**** |
| Wild raids | 0.016 | 0.019 | 0.035 |
| Domestic raids | **0.068*** | **0.085**** | **0.071*** |

Whilst buildings are also present in the majority of cells where wild raids are recorded, the association is not significant.

### *5.3.7 Identifying the Probability of Crop Raids using Key Environmental Variables*

Binary logistic regression analysis was implemented for each season to examine the relationship between raid presence and environmental factors. Crop protection strategies (guarding/ non-lethal and lethal methods) are also included in the model but will be discussed in Chapter 7. The procedure is repeated for all raids in addition to those by wild and domestic species. Raids by primate species are not examined separately as splitting the data further would have compromised the power of the model. Spatial autocorrelation of the dependent variable was not significant for this sample and grid cells can be considered independent.

During Season 1, distance from forest had a significant effect upon the presence of all raids but particularly those by wild species. The negative value (B) and odds ratio (1-Exp(B)) indicate that the risk of damage events from wild animals is reduced by 0.01 for every one metre from the forest edge:

**Table 5.12 Logistic regression analysis of factors affecting the presence of damage events during Season 1 (N=1247). A positive coefficient (B) indicates an increased likelihood of raid presence and negative a reduced likelihood.**

| *Factors* | *B* | *Exp(B)* | *SE* | *Wald* | *Significance* |
|---|---|---|---|---|---|
| **All Raids** | | | | | |
| Forest Distance | -0.006 | 0.994 | 0.001 | 24.408 | $P<0.001$ |
| Maize | 0.831 | 2.295 | 0.265 | 9.795 | $P<0.01$ |
| Sweet Potato | 0.484 | 1.622 | 0.206 | 5.525 | $P<0.05$ |
| Constant | -1.953 | 0.142 | 0.289 | 45.830 | $P<0.001$ |
| **Wild Raids** | | | | | |
| Forest Distance | -0.010 | 0.990 | 0.001 | 44.643 | $P<0.001$ |
| Guarding | -0.522 | 0.593 | 0.245 | 4.535 | $P<0.05$ |
| Maize | 0.650 | 1.916 | 0.289 | 5.066 | $P<0.05$ |
| Constant | -1.307 | 0.271 | 0.346 | 14.254 | $P<0.001$ |
| **Domestic Raids** | | | | | |
| Maize | 1.581 | 4.862 | 0.603 | 6.881 | $P<0.001$ |
| Sweet Potato | 0.837 | 2.311 | 0.296 | 7.989 | $P<0.001$ |
| Constant | -4.709 | 0.009 | 0.582 | 65.503 | $P<0.001$ |

Maize also has a significant effect. Its presence increased the likelihood of raids occurring almost fivefold for domestic species and almost double for wild animals (Exp(B)=4.862 and 1.916 respectively). Sweet potato shows a similar relationship and raids by domestic species are more than two times more likely if it is present (Exp(B)=2.311).

Season 2 showed similar patterns to Season 1; distance from the forest edge is a significant factor in the presence of raids by wild and domestic species (Table 5.13). However, the positive coefficient (B) demonstrates that, unlike wild raids, an increase in distance from forest increases the likelihood of raids from domestic animals. Maize is also a significant factor in the presence of raids by wild and domestic species, increasing their likelihood substantially (wild Exp(B)=2.187; domestic Exp(B)=4.783).

**Table 5.13 Logistic regression analysis of factors affecting the presence of damage events during Season 2 (N=1231). A positive coefficient (B) indicates an increased likelihood of raid presence and negative a reduced likelihood.**

| *Factors* | *B* | *Exp(B)* | *SE* | *Wald* | *Significance* |
|---|---|---|---|---|---|
| **All Raids** | | | | | |
| Forest Distance | -0.006 | 0.994 | 0.001 | 29.340 | P<0.001 |
| Guarding | -0.893 | 0.409 | 0.209 | 18.204 | P<0.001 |
| Maize | 1.251 | 3.494 | 0.273 | 21.030 | P<0.001 |
| Constant | -1.455 | 0.233 | 0.290 | 25.101 | P<0.001 |
| **Wild Raids** | | | | | |
| Forest Distance | -0.011 | 0.989 | 0.002 | 48.009 | P<0.001 |
| Guarding | -1.095 | 0.334 | 0.254 | 18.598 | P<0.001 |
| Maize | 0.783 | 2.187 | 0.322 | 5.912 | P<0.05 |
| Constant | -1.196 | 0.302 | 0.332 | 12.984 | P<0.001 |
| **Domestic Raids** | | | | | |
| Forest Distance | 0.005 | 1.005 | 0.002 | 9.302 | P<0.001 |
| Maize | 1.565 | 4.783 | 0.648 | 5.837 | P<0.05 |
| Constant | -5.749 | 0.003 | 0.684 | 70.580 | P<0.001 |

The results from Season 3 were quite different and indicate the presence of other variables that can impact upon raid presence (Table 5.14). For example, distance from fallow was found to have a significant ($p<0.05$) impact upon domestic raids; moving one metre away from fallow land was found to decrease the chance of raids by 0.007. In addition, the presence of cassava more than tripled the likelihood of a field being raided by domestic species (Exp(B)=3.486, $p<0.05$). Again, raids by wild species were strongly related to the distance from the forest edge. Interestingly, the absence of sweet potato increased the likelihood of a field being raided by wild species (Exp(B)=0.409).

**Table 5.14 Logistic regression analysis of factors affecting the presence of damage events during Season 3 (N=1222). A positive coefficient (B) indicates an increased likelihood of raid presence and negative a reduced likelihood (*p<0.05, **p<0.01, p<0.001).**

| *Factors* | *B* | *Exp(B)* | *SE* | *Wald* | *Significance* |
|---|---|---|---|---|---|
| **All Raids** | | | | | |
| Fallow Distance | -0.006 | 0.994 | 0.003 | 6.215 | P<0.05 |
| Cassava | 1.161 | 3.193 | 0.331 | 12.273 | P<0.001 |
| Constant | -2.724 | 0.066 | 0.429 | 40.375 | P<0.001 |
| **Wild Raids** | | | | | |
| Forest Distance | -0.011 | 0.990 | 0.003 | 12.997 | P<0.001 |
| Sweet Potato | -0.895 | 0.409 | 0.363 | 6.099 | P<0.05 |
| Constant | -4.825 | 0.409 | 1.115 | 18.739 | P<0.001 |
| **Domestic Raids** | | | | | |
| Fallow Distance | -0.007 | 0.993 | 0.004 | 4.038 | P<0.05 |
| Cassava | 1.249 | 3.486 | 0.524 | 5.685 | P<0.05 |
| Constant | 3.582 | | 0.459 | 60.776 | P<0.001 |

To produce risk maps that display the probability of a raid event for each grid cell, the above coefficients were entered into the GIS using the formula described in Section 5.2.4 (Figure 5.19-5.27). For example, the probability of raids occurring in Season 1 in a grid cell 1m from the forest edge growing maize and sweet potato can be written as:

$$\text{Prob (raids)} = \frac{1}{1 + e^{-Z}}$$

where Z = -1.953 – 0.006(1) + 0.831(1) + 0.484(1) = -0.644

$$\text{Prob (raids)} = \frac{1}{1 + e^{-(-0.644)}} = \mathbf{0.345}$$

Usually 0.5 is considered an appropriate cut off when attempting to ascertain the likelihood of an event (Norusis, 1999). However, in this model even grid cells with the highest probability of raids were not over this threshold. For example, high-risk cells in Season 2 still only had a 45% chance of raids.

Figure 5.19 Risk maps indicating the probability of crop loss in Kyempunu in Season 1; a) all raids, b) wild raids and c) domestic raids. Observed raids are overlaid to indicate success of the model.

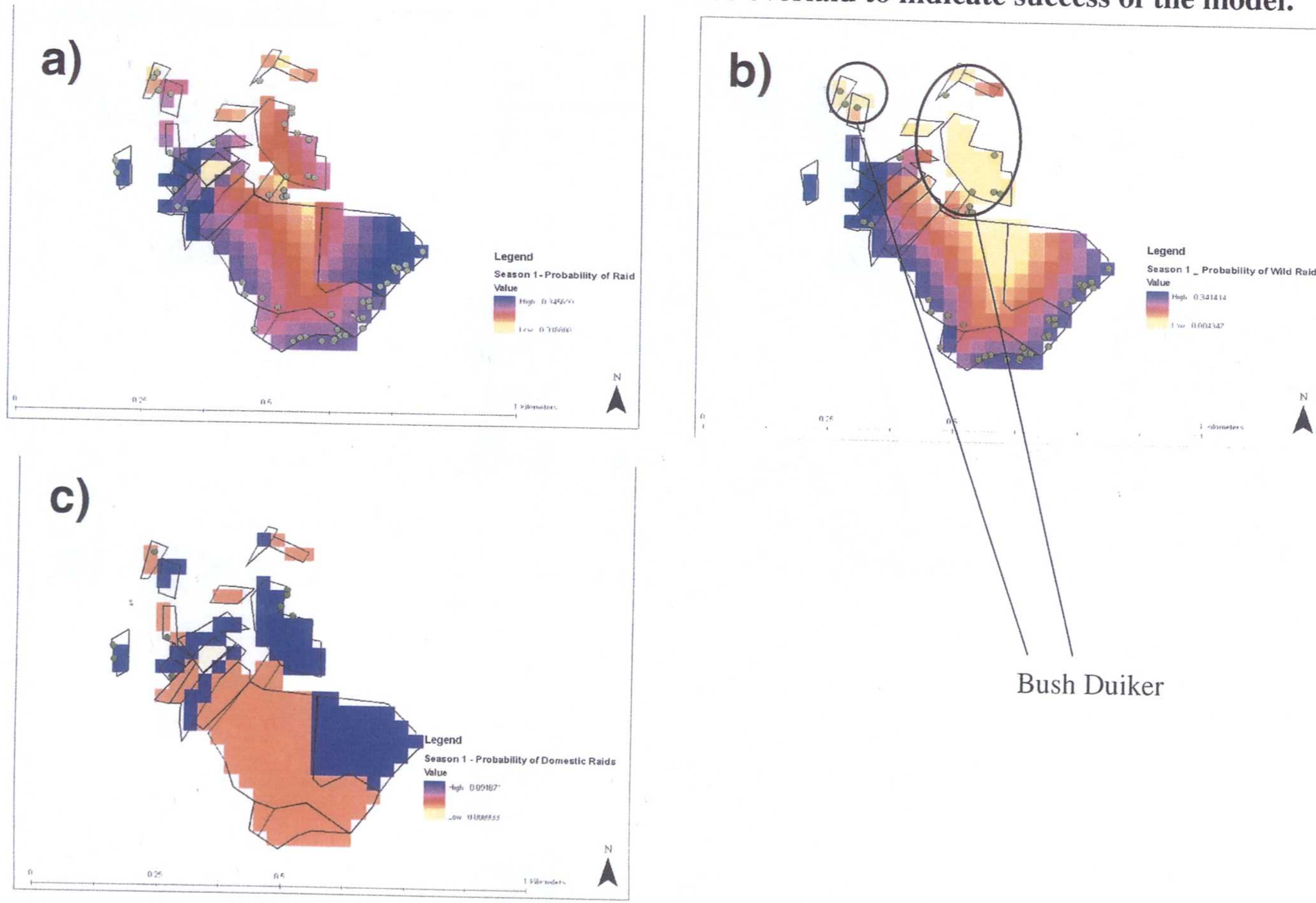


**Figure 5.20 Risk maps indicating the probability of crop loss in Nyakafunjo and Nyabyeya II in Season 1; a) all raids, b) wild raids and c) domestic raids. Observed raids are overlaid to indicate the success of the model.**

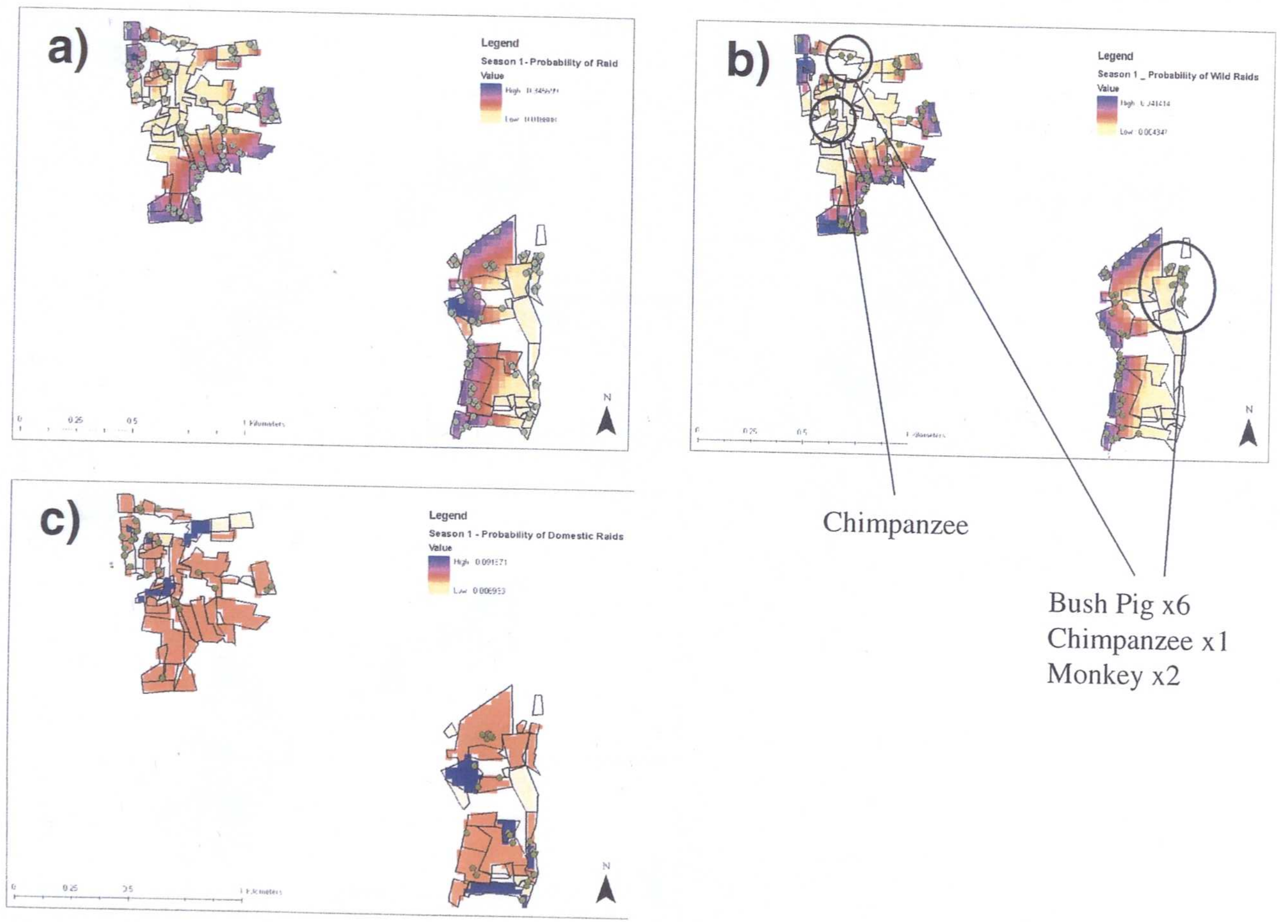


Figure 5.21 Risk maps indicating the probability of crop loss in Fundudolo in Season 1; a) all raids, b) wild raids and c) domestic raids. Observed raids are overlaid to indicate the success of the model.

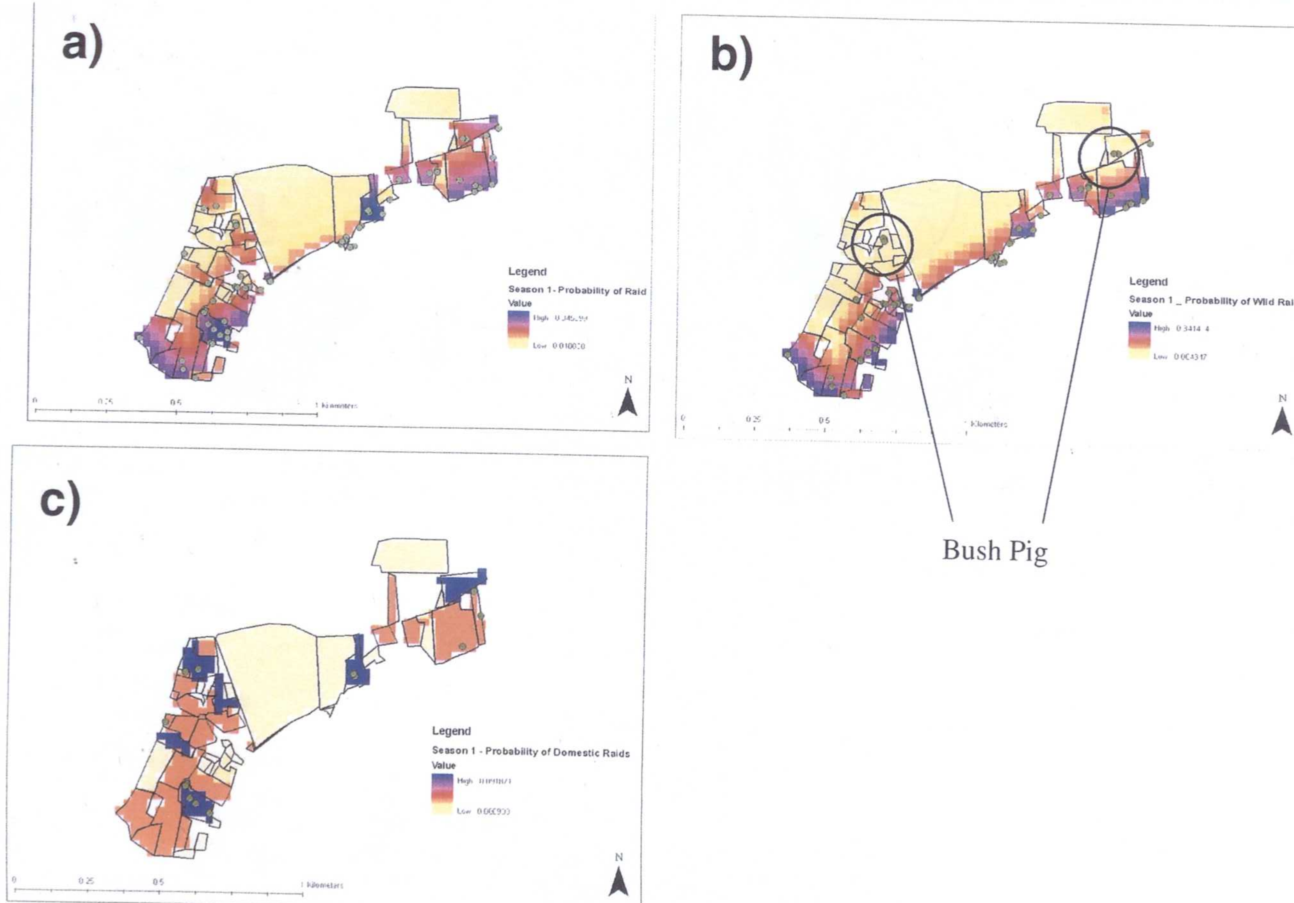


Figure 5.22 Risk maps indicating the probability of crop loss in Kyempunu in Season 2 ; a) all raids, b) wild raids and c) domestic raids. Observed raids are overlaid to indicate the success of the model.

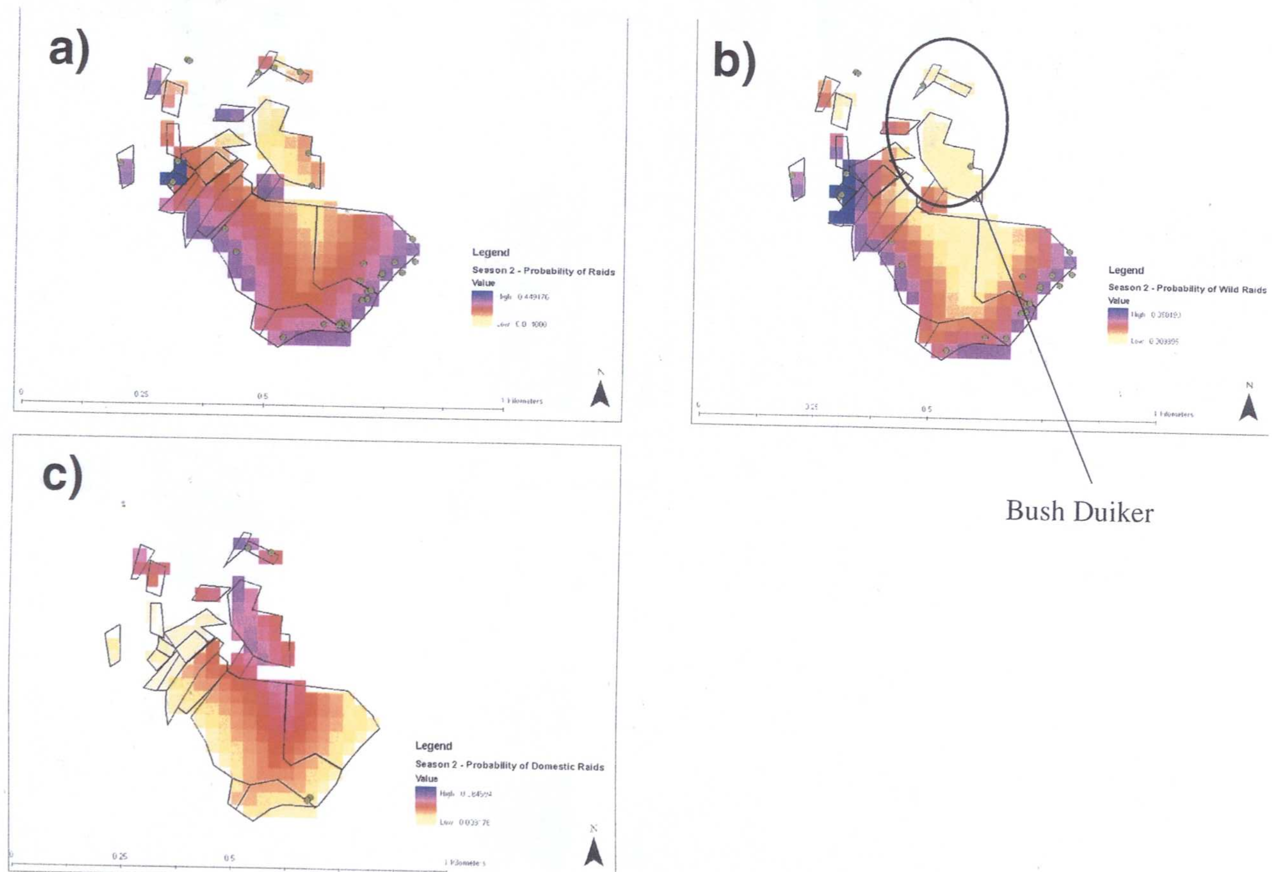


Figure 5.23 Risk maps indicating the probability of crop loss in Nyakafunjo and Nyabyeya II in Season 2; a) all raids, b) wild raids and c) domestic raids. Observed raids are overlaid to indicate the success of the model.

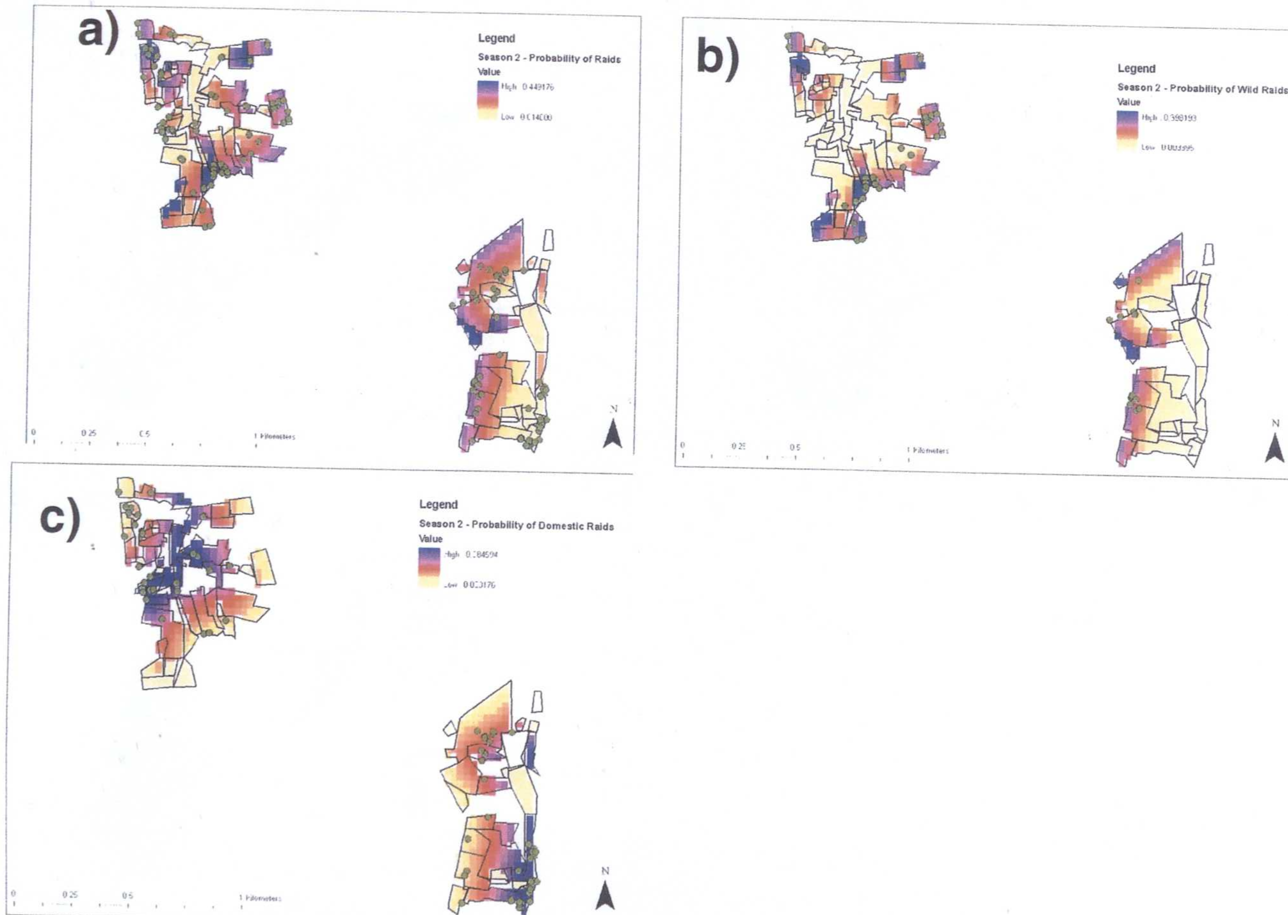


Figure 5.24 Risk maps indicating the probability of crop loss in Fundudolo in Season 2; a) all raids, b) wild raids and c) domestic raids. Observed raids are added on top to indicate the success of the model.

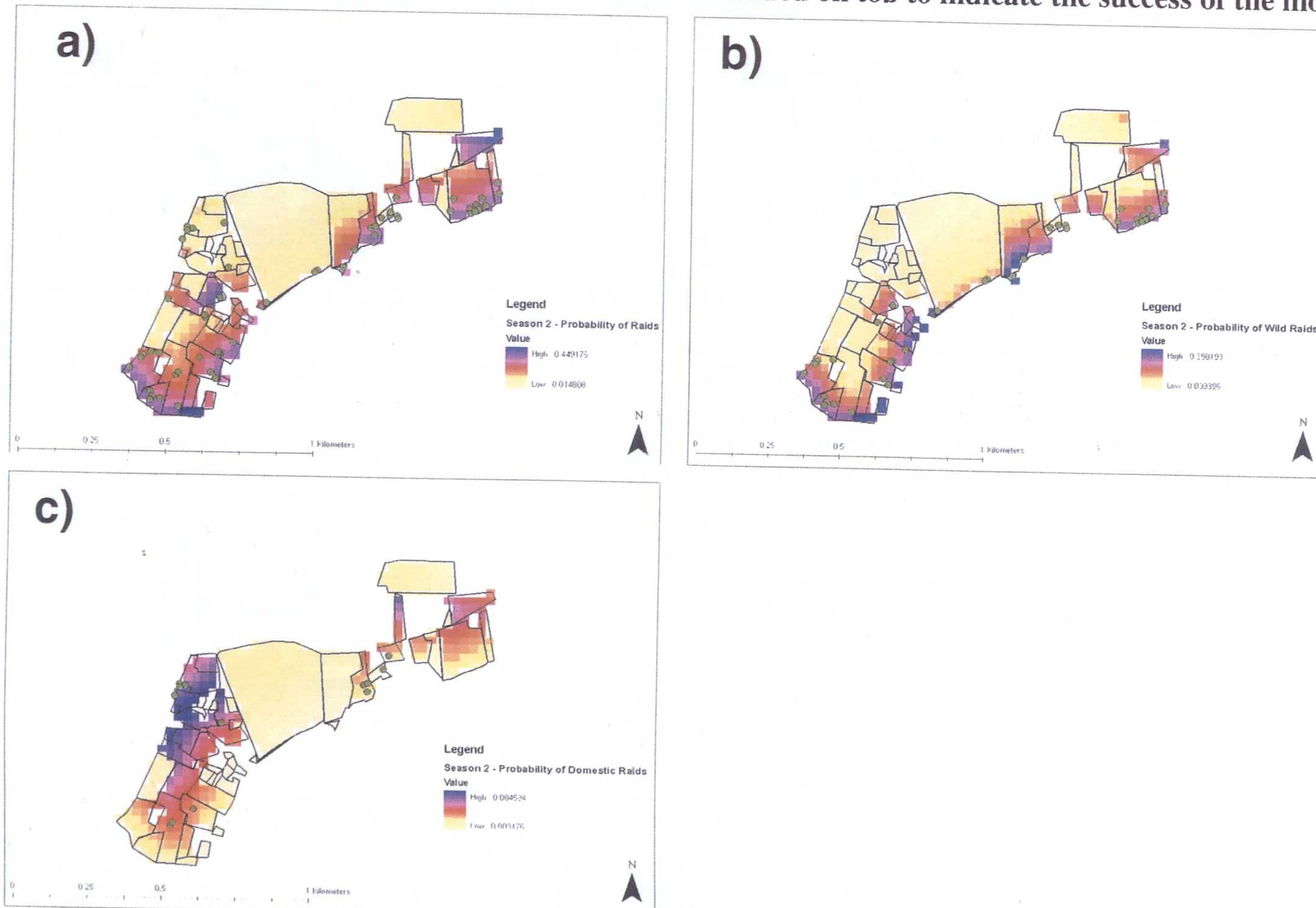


**Figure 5.25 Risk maps indicating the probability of crop loss in Kyempunu in Season 3; a) all raids, b) wild raids and c) domestic raids. Observed raids are added on top to indicate the success of the model.**

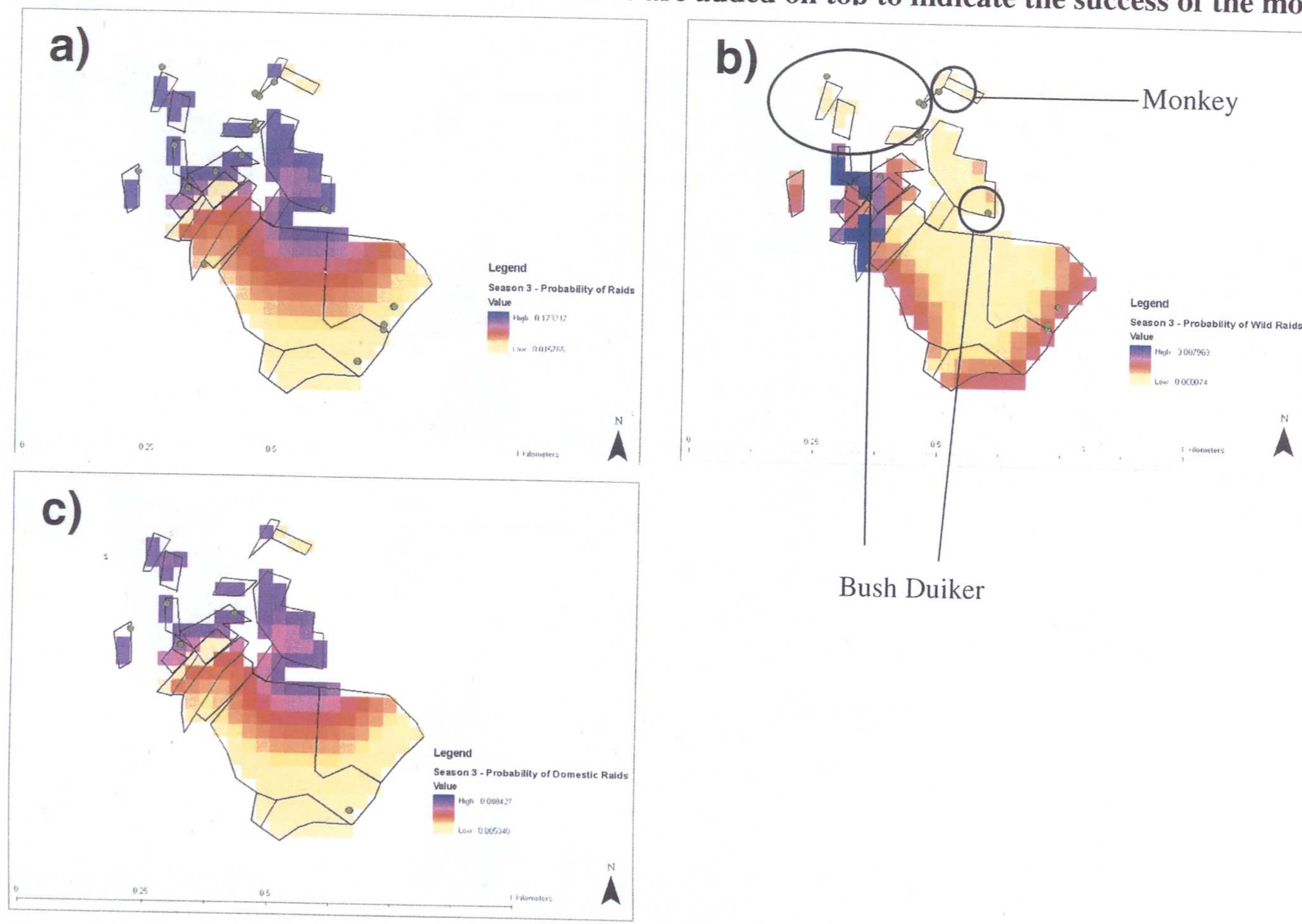


Figure 5.26 Risk maps indicating the probability of crop loss in Nyakafunjo and Nyabyeya II in Season 3; a) all raids, b) wild raids and c) domestic raids. Observed raids are added on top to indicate the success of the model.

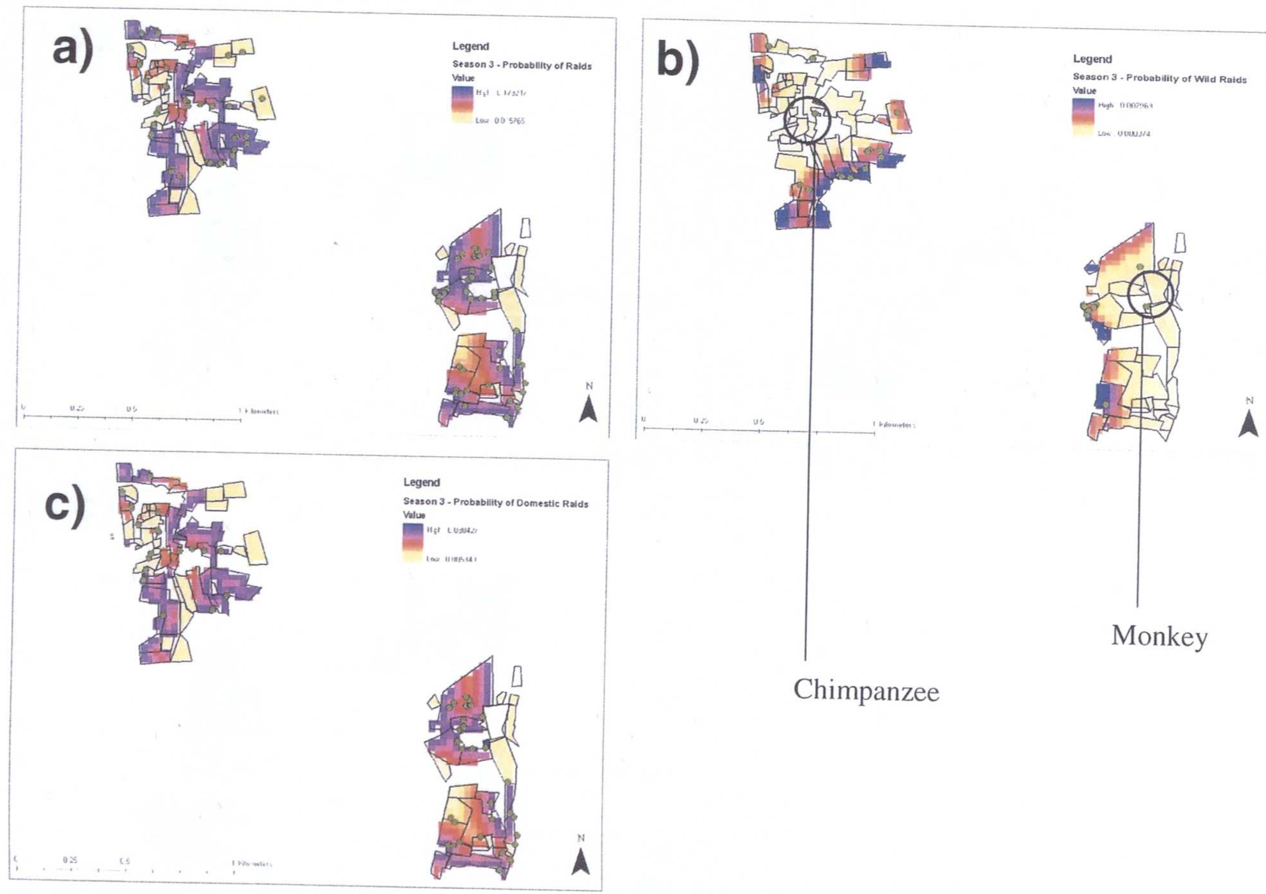
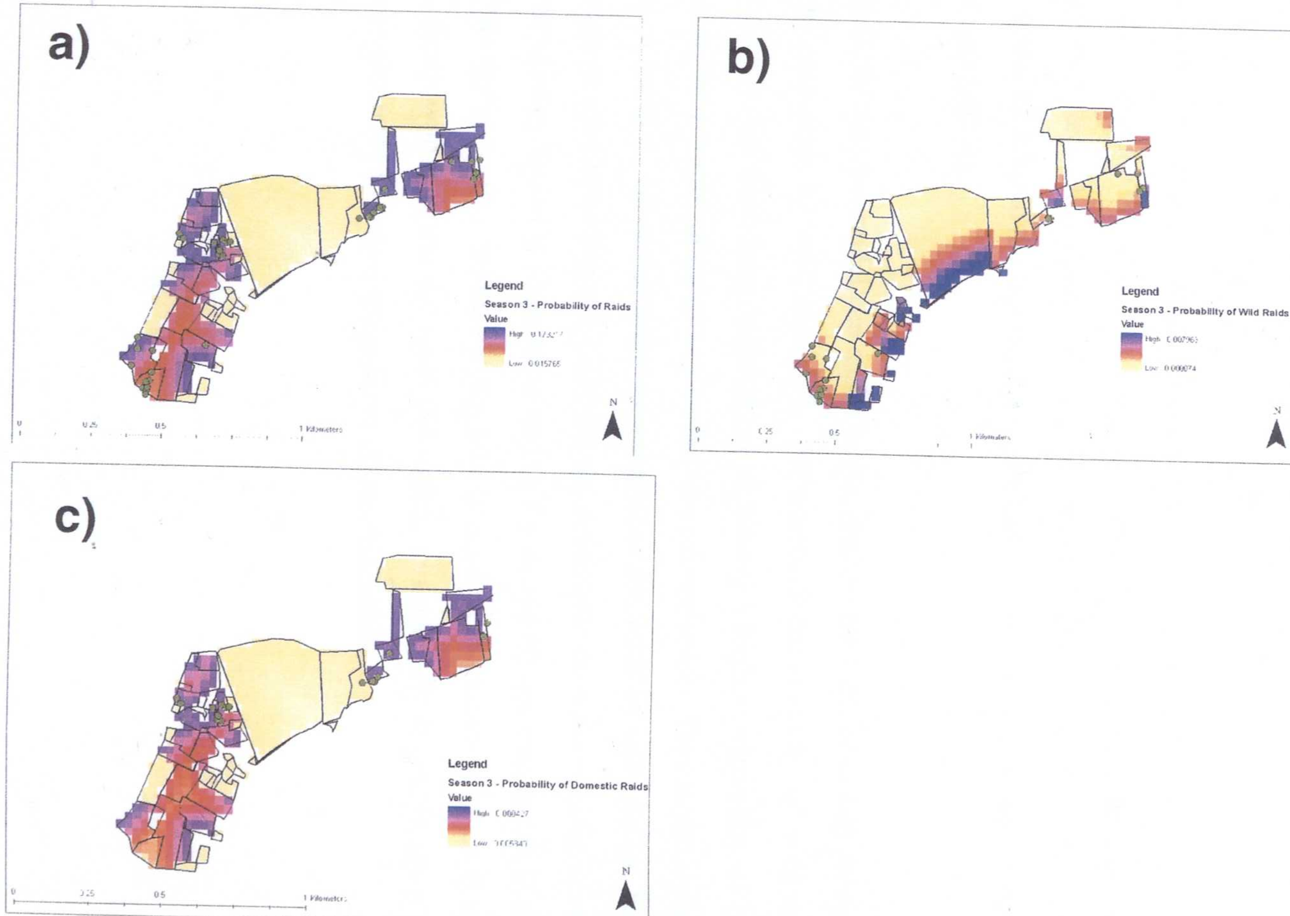


Figure 5.27 Risk maps indicating the probability of crop loss in Fundudolo in Season 3; a) all raids, b) wild raids and c) domestic raids. Observed raids are added on top to indicate the success of the model.



Probabilities for domestic animals are particularly low. For example, the probability of domestic raids occurring in season 1 in a grid cell growing maize and sweet potato is:

$$\text{Prob (raids)} = \frac{1}{1 + e^{-z}} = \mathbf{0.091} \text{ (where } Z = -4.709 + 1.581(1) + 0.837(1) = -2.291)$$

The results show that although these cells are most vulnerable from domestic raids, the model can only calculate the result to a very low probability. This indicates that some caution must be taken when interpreting the results of the GIS modeling. However, overlaying actual raids on to the risk maps reveals that the findings can provide a useful indicator of vulnerability.

The maps indicate that the model can assist in the identification of areas that are most vulnerable to crop raids by wild species[34]. For example, the majority of wild raids occur in grid cells that have been highlighted as having a higher probability of raid presence due to their combination of key environmental variables. This is particularly clear in Season 1 and 2. However, there are exceptions and raids by bush duiker, bush pig and chimpanzee are not always in cells that are considered more vulnerable to crop loss. Several monkey raids (in Kyempunu and in Nyabyeya II) are also not in a high risk area of the research site. Whilst having general success in identifying factors that influence raids by wild species, the model is unable to accurately highlight areas of farms that are vulnerable to crop damage from domestic animals.

[34] The risk maps and the GIS model are created from the same data. Whilst the model can only explain a small amount of variance, it is useful as a general indicator of vulnerability.

## 5.4 Discussion

### *5.4.1 Crop Damage Factors*

Although it is clear that large vertebrates cause a significant amount of damage around BFR, farmers are vulnerable to a number of crop damage factors.

Crop disease is a significant problem for local people and the arrival of banana wilt in this area has had a devastating effect upon banana plants. It is not clear if this is caused by *Fusarium* fungus or *Xanthomonas* bacterial disease; the latter was first recorded in Uganda in 2001 and is now spreading rapidly throughout the country (INIBAP, 2006). Both wilt conditions can be transmitted by insects and therefore the most effective way to eradicate them is to destroy the affected stem. This is a substantial loss for a subsistence farmer. Insects are also a major issue and their damage is recorded in more farms than any other problem. In addition, stemborers and termites cause significant loss to many crops, particularly maize (Chitere and Omolo, 1993). As damage is often not visible until the plant has reached maturity, the farmer risks losing every affected stem.[35] Pesticides are expensive and seldom used in this area so local people are limited in the manner by which they can respond. However, lack of resources may not be the only factor to impact upon the amount of insect damage observed; in Kenya, farmers are willing to tolerate high amounts of loss to insects (Conelly, 1987). Thus it is possible that local people may not perceive damage by insects or termites to be a significant cause of crop damage. Chapter 6 will examine this issue further.

The weather can also limit crop yield. The large, soft leaves of tobacco are particularly vulnerable to hailstones and any tears or holes will reduce the quality of the crop and therefore the financial return (Eggeling, 1947, Baker, 1971). This is a contributing factor to the reduction of tobacco cultivation in this area; severe weather in Season 1 contributed to a poor harvest with a subsequent drop in income. British American Tobacco also failed to buy from many outgrowers in the Masindi District due to a

[35] If the farmer responds quickly, cobs may be retrieved. However, any fallen stems will be at risk of further damage by small vertebrates and rodents (Mitchell, 2002).

surplus in the international market (Nsambu, 2005). Farmers were, understandably, reluctant to risk such financial loss the following year.

A considerable amount of crop damage by local people was also observed and this ranged from accidental loss (e.g. vehicles flattening stems) to deliberate removal (e.g. children and adults are frequently encountered eating sugar cane or taking it from the edge of fields – Figure 5.3). The majority of subsistence farmers are limited financially from growing cane but the amount of land converted to this cash crop is rising steadily in this area as local people invest in the outgrower programme (Chapter 2). Discussions with those that are growing the crop indicate potential conflict:

> "My problem is with people who eat canes. At least baboons don't have a garden and damage less. People will cut one, not like it and cut another. I stop my family but other people just take".

Nearby villages have already experienced problems because of sugar cane; where farmers have refused to compensate people for displacement or denied access to the local community, cane fields have been deliberately burnt (New Vision, 2005, *pers obs*). All the above points indicate that although large vertebrates are a significant problem, they are not the only cause of crop loss and potential conflict to farmers at this site.

*5.4.2 Crop Damage by Large Vertebrates*

This study reveals that a number of large vertebrates, both wild and domestic, utilize human foods around BFR. However, the level and type of damage is different for specific animals and, consequently, farmers are exposed to varying levels of risk.

Baboons damage more cultivated crops than any other large vertebrate species. This has been found at other sites (Else, 1991, Andama and McNeilage, 2003) and at Kibale National Park they are responsible for a greater amount of loss than elephants (Naughton-Treves, 1996). Baboons damage a wide range of agricultural crops; whilst they eat predominately maize, they are highly adaptable and will shift to cassava, fruit or sweet potato if maize is unavailable (Naughton-Treves, 1997, 1998, Naughton-

Treves *et al.*, 1998, Hill, 2000, Chalise, 2000/1). However, baboons do not only eat staple foods such as maize and cassava, they also damage cash crops i.e. tobacco. It is not understood why baboons persist in chewing tobacco stems as they are toxic and usually avoided by animals (Bell, 1984). Farmers often become ill when harvesting the crop as high levels of nicotine are absorbed through the skin (D'Alessandro *et al.*, 2001). However, baboon damage to tobacco has been reported in other studies in this area (Paterson, 2005) and there is the possibility that baboons gain some stimulation or protection from the activity as opposed to any nutritional value. For example, other studies suggest that tobacco can remove parasites from animals (Kagoro-Rugunda, 2004)[36]. Baboons also eat many different plant parts at varying levels of maturity and, although a high proportion of damage events in this study are on immature foods, these animals present a risk to farmers throughout the growing cycle (Naughton-Treves, 1996, Hill, 2000, Warren, 2003). By consuming staple foods and cash crops throughout the crops' maturation, baboons are capable of causing significant economic loss at times of food shortage. Local people are not always able to recover quickly from damage (Putman, 1989); for example, replanting may not be possible due to lack of supplementary seed stock or inadequate rainfall (Hill, 2000, Tweheyo *et al.*, 2005). Baboons are not the only primate to utilize human food crops during this study.

Around BFR monkeys frequently consume agricultural produce but, unlike baboons, they are not responsible for a high level of damage. This has been seen at other sites throughout Africa (Else, 1991, Naughton-Treves, 1996). Monkeys predominately eat fruit (e.g. pawpaw and banana) and maize. This preference for tall crops may be associated with a lower risk of predation (Horrocks and Baulu, 1994) and increased opportunism. As found in Naughton-Treves (1996), monkey damage is relatively consistent, monkeys forage on fruits throughout the year but peaks of damage coincide with maize development. Consequently, the risk they represent to farmers is low but sustained throughout the agricultural season.

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[36] This reference is anecdotal and the researcher states that bush pig use the plant to rid themselves of lice. Without further data it is impossible to ascertain if this is coincidental or whether tobacco has therapeutic properties. However, it does suggest the relationship between animals and this cash crop may be more complex than first imagined.

Chimpanzees also consume human foods at the study site but the damage they cause is negligible in comparison with other raiding wildlife. As with other studies in Uganda, they were recorded eating mainly fruit and sugar cane (Naughton-Treves, 1996, Tweheyo *et al.*, 2005). Whilst they cause little damage overall, by eating cash crops, chimpanzees have the potential to cause considerable economic loss; outgrowers do not get paid until the cane is harvested and replanting due to damage is not possible as the company provide initial seedlings. This is a concern as more people convert land to cane in the hope of a substantial income. In an attempt to mitigate the problem, it is a requirement of Kinyara Sugar Works Ltd (KSWL) that all outgrowers leave a 20m cleared buffer area between the forest edge and sugar cane fields in order to deter chimpanzees (Reynolds 2006, *pers comm.*)[37]. However, this has never been observed at the study site. Whilst primates are clearly a problem around BFR, other large vertebrate species also cause significant damage to food and cash crops.

Bush pig are considered a major problem in agricultural areas across Africa (Vercammen *et al.*, 1993). Like *Sus scrofa*, they not only eat crops but can also cause significant damage through trampling and rooting (Barrett and Birmingham, 1994, Rao *et al.*, 2002, Schley and Roper, 2003, Kagoro-Rugunda, 2004, Priston, 2005). In this study they were responsible for a high number of raids and the second highest amount of damage for all wild species. Although pigs eat a wide range of foodstuffs (Brooks *et al.*, 1989, Schley and Roper, 2003), they predominately raid tubers (i.e. cassava, yam and sweet potato) and maize cobs (Naughton-Treves, 1996, Priston, 2005). In Pakistan, bush pig are considered to be a major problem to sugar cane plantations (Brooks *et al.*, 1989), but this was not seen around BFR nor was it mentioned by local people. Like baboons, they also damage crops throughout their growing cycle thus causing considerable loss to subsistence farmers.

Domestic animals (e.g. goats, pigs and sheep) are also responsible for a significant number of crop raids and subsequent damage at the study site. They have been

[37] Negotiations between BFP and KSWL have been ongoing regarding this issue. However, due to the current privatization of the factory it is unclear as to whether these rules will be included in future outgrower contracts.

highlighted as a major contributor to crop loss around Kibale National Park, where livestock are responsible for 17% of all raid events (Naughton-Treves, 1996). Although domestic animals eat mainly the leaves of immature foodstuffs, this study reveals the considerable impact that leaf removal can have on maize yield. Pruning just once a month reduces the size and weight of a cob significantly. Therefore, whilst the damage from domestic species, such as goats, looks superficial, it can have a significant effect upon a plant's development (see also Fox *et al.*, 1996). However, this is not seen with all crops or grazing species; for example, in India, some local people believe that blackbuck grazing increases yield (Jhala, 1993). Further research is required to understand whether grazing on bean or cassava leaves by goats and bush duiker at this site has a similar impact upon crop yield as maize.

### *5.4.3 Factors that Influence Vulnerability of Crop Damage*

The majority of farmers experience little crop damage by large vertebrates but a few local people suffer considerable loss, as has been found in other studies (Naughton-Treves, 1996, Hill, 2000, Gillingham and Lee, 2003, Warren, 2003). Several key factors influence whether a farm experiences crop raids; the types of crops grown and distance from forest/ plantations or fallow.

#### 5.4.3.1 Crops Grown

The presence of food crops is closely associated with the presence and temporal variation of large vertebrate damage around BFR. The fall in frequency of crop raids during study season 3 is due to fewer crops being planted as has been found at other sites of human-wildlife conflict (Sukumar, 1990). Peaks in raiding frequency also associate with rainfall; as rain fed crops mature they become more vulnerable to damage by animals (see also Naughton-Treves, 1996). However, this study indicates that not all foods are equally affected; some cultivars were not damaged at all during the study (pineapple, aubergine, avocado, coffee, okra and chilli) and their potential as buffer crops will be discussed in Chapter 8. Others, such as fruit trees, experience a low but relatively consistent level of damage throughout the year. It is the presence of maize, cassava and sweet potato that appear to make fields most vulnerable to raids by both wild and domestic animals.

Maize is the most commonly grown food crop in this area (Hill, 1997). As a rain-fed crop, is ideally suited to the first agricultural season (study seasons 1 and 2) as it takes ten to twelve weeks to mature and if planted at this point the farmer is able to utilize the short dry season in August to dry the cobs (Yayock *et al.*, 1988). In contrast, the second agricultural season (season 3) has limited rainfall and sun-damaged maize was frequently observed during this growing period. Cassava is also grown by many farmers and, like maize, is important in 'local food culture' (Hill, 2000). Unlike maize, it is can survive prolonged periods of drought and can be left in the field indefinitely (Yayock *et al.*, 1988). Farmers, therefore, utilize cassava as a 'famine crop', a valuable source of starch that can be used during food shortage (Mascarenhas, 1971, Nyangabyaki, 1991). This hardiness also explains why it is planted consistently throughout the year. Sweet potato, in contrast, is not one of the most commonly planted crops at this site. Many local people only grow it in the second season as, although it initially requires substantial rainfall, after six weeks sweet potato can withstand high levels of drought (Yayock *et al.*, 1988). Like maize, it has a short growing season and matures simultaneously (Naughton-Treves, 1996); thus, if substantial damage is sustained, the farmer risks losing all the crop.

A considerable quantity of maize was damaged in this study, more than double the amount of any other crop. Its high protein content (Sukumar, 1990) and obvious visual presence appear to attract both wild and domestic animals. Indeed, in other studies, raids to maize have not been associated with forest fruit availability (Naughton-Treves *et al.*, 1998). Some farmers around BFR remove the tassels of developing maize as they believe raiding species can ascertain the maturity of the cob from the silk at the top of the ear. The presence of maize in a farm may also put other crops at risk; a high proportion of damage in maize farms is not to this crop. It suggests that animals (e.g. baboons) may be attracted to the field by maize but will damage other food crops if maize is not yet mature and alternatives are available. For example, in season 3, less maize is grown and yet a high proportion of raids to maize farms are not on the crop. This is surprising and could indicate a food preference; sweet potato experiences a rise in planting and subsequent raids at this time. However, it is also possible that maize had not yet matured in villages around BFR and raiding animals were forced or preferred to utilize other agricultural foodstuffs. This is supported by analysis of the rainfall patterns in season 3. Crop raids in season 1 and 2 clearly escalate several months after the peak in rainfall and this coincides with the required development of rain-fed crops. However, rainfall was at its peak at the end of study season 3 and it is likely that the maize crop did not fully mature for a month after this project was completed. Anecdotal evidence supports this assumption and the goat damage plots were not harvested until late November[38]. It should be recognized that, in this study, maize is also the most frequently grown cultivar and a high level of damage may not reflect a food preference but merely the most available foodstuff.

5.4.3.2 Distance from the Forest Edge or Fallow

Distance from forest, degraded forest or plantation is a key factor influencing crop damage by wild animals for all seasons around BFR. In some respects, this is unsurprising as the majority of these animals live, sleep and forage in forest habitats. Wild species are also likely to travel only a limited distance into agricultural areas as the further the incursion, the greater the risk of injury and/ or death (Saj *et al.*, 2001). However, the relationship with the forest edge is different for each species. Whilst predominately consuming crops close to the forest boundary, chimpanzees do on occasion move deep into agricultural areas to obtain fruit or sugar cane (Tweheyo *et al.*, 2005). This may reflect greater public tolerance for these species as opposed to a decreased sense of risk (Chapter 6 will examine this further). Monkey damage is usually associated with tree cover however some raids were seen away from forest areas. It is believed that these incursions were caused by vervet monkeys who are more likely to be observed in more open areas or plantation (Plumptre and Reynolds, 1994,

[38] Data suggests that rainfall is usually distributed from August to October (Eggeling, 1947, Paterson, 1991, Tweheyo *et al.*, 2005). However, many local people stated that the rains were late in 2005 and figure 3.1 indicates that much less rain fell in Sept 05 compared with Sept 04. Indeed, there was a low level of rainfall throughout the second agricultural season and many parts of East Africa experienced a severe drought in early 2006 (BBC, 2006b).

Hill, 1997). Bush pig damage is also recorded at a distance from the forest and regression analysis found it difficult to identify areas of vulnerability for this species (see also Bell, 1984, Naughton-Treves, 1996). This may be a result of their nocturnal raiding habits as under cover of darkness they can penetrate far into farm land without being detected (Priston, 2005). Anecdotal and *ad hoc* evidence also suggests that bush pig raid more often and travel further into agricultural areas during nights with heavy rain. This supports previous work indicating that pig rooting occurs more frequently in wet locations (Barrett and Birmingham, 1994, Hone, 1995).

Damage by domestic species does not have a relationship with the location of forest, degraded forest or plantations. However, these animals are dependent on humans for shelter/ food and, to an extent, patterns of movement. Goats are usually tethered to buildings or in fallow areas and the damage events they cause are frequently observed close to human habitation or along paths between homesteads and grazing land. It is unsurprising therefore, that distance from fallow has a negative relationship with crop damage by domestic animals; raids by goats, cows and sheep are more likely to happen close to uncultivated areas. Livestock damage also has significant relationships with all crop types which suggest that domestic species are not selective but opportunistic. Whilst buildings are not a significant indicator of vulnerability to crop loss, they were one of the final factors to be eliminated from regression analysis (season 2) indicating that they also may impact upon crop damage by domestic species. For domestic animals, there is an indirect relationship between the presence of people and crop loss.

Distance from fallow does not significantly impact upon damage events by wild species when all variables are factored into the regression. However, initial analysis and previous studies reveal there may be some association and wild animals may use bush or fallow areas as a refuge and/or corridor to raid nearby cultivars (Naughton-Treves, 1997, Hill, 2000, Andama and McNeilage, 2003, Gillingham and Lee, 2003, Kagoro-Rugunda, 2004, Priston, 2005). For example, gorillas and baboons are able to move undetected in the tall grasses and low lying bush and yet can remain vigilant to approaching humans (Madden, 1999, Hill, 2000, Warren, 2003).

### 5.5 Summary

Agricultural crops around BFR can be damaged by a wide range of factors including birds, weather, insects and people. However, large vertebrates are responsible for a high proportion of damage and eleven species were recorded foraging or trampling on seventeen different crop types. Primates are a particular problem and baboons cause the most damage of any large vertebrate at this site. Goat damage was also frequently observed and although it appears superficial, this study demonstrated that, for maize, consistent pruning can significantly reduce crop yield. The presence of maize and proximity to forest increase the probability of damage by wild species. Raids by domestic animals increase close to fallow and with all the crops tested (maize, sweet potato and cassava). However, the dependency of domestic species upon humans may indicate that they do not display a preference for specific crops but will utilize what is available (Naughton-Treves, 1998).

In conclusion:

1. Large vertebrates are not the only cause of crop damage around BFR; a wide range of damage factors are observed in farms, and insects and termites/ stemborers are a particular problem at this site.

2. Many different animals utilize human foods around BFR including domestic and wild species. Primates cause a significant proportion of the damage; baboons, monkeys and chimpanzees all eat crops at this site. In addition, bush pig, bush duiker and goats are responsible for a high number of raids and area lost to crop damage. Domestic species graze predominately on leaves and this was demonstrated to have a considerable impact upon crop yield.

3. Crop damage by large vertebrates is not evenly distributed across the study sample. Local people living close to animal habitat and/ or cultivating maize

and cassava are at greater risk of crop loss by wild species. Temporal variation is due to the type and amount of food crop being cultivated.

4. GIS analysis may not be an appropriate method to highlight areas of farmland vulnerable to incursions by domestic species. The movement of sheep, goats and cattle is dependent upon humans and therefore not necessarily related to spatial or environmental factors.

# 6. RESULTS: PERCEPTIONS OF CROP LOSS AND RAIDING SPECIES

## 6.1 Introduction

Understanding people's perceptions is an essential, and often neglected, element of the study of human-wildlife conflict and conservation generally (Kellert, 1985). Whilst quantifying crop damage has a fundamental role in determining loss, it may not provide an accurate representation of the actual impact upon affected communities (Bell, 1984, Hill *et al.*, 2002, Hill, 2004, Naughton-Treves and Treves, 2005, Priston, 2005). For example, the economic loss sustained by raiding wildlife can also result in substantial social costs, e.g. reduced food availability, health care, education, labour, land tenure and access to resources. These costs can lead to negative attitudes towards animals and an increased perception of risk. This can reduce tolerance for wildlife and impede the success of conservation initiatives (Newmark *et al.*, 1993, Naughton-Treves, 1997, De Boer and Baquete, 1998, Gillingham and Lee, 1999, Riley and Decker, 2000, Hill, 2004). Conversely, the study of attitudes may reveal that local people do not perceive a problem with raiding wildlife and are willing to tolerate loss (e.g. Jhala, 1993, Alexander, 2000). This may be due to cultural values, religious beliefs or familiarity and demonstrates that mitigation is not always appropriate and may focus upon a conflict that does not exist (Priston, 2005). Therefore, perceptions of risk and wildlife need to be thoroughly examined in order to understand the social and economic impact of 'crop raiding' on local people.

Social studies into crop damage are also important because attitudes toward animals and their utilization of human foods may not reflect actual loss. For example, wild species are often reviled for causing damage even though domestic animals are responsible for a high proportion of the loss (Naughton-Treves, 1996). In addition, specific species may attract attention due to their large body size, gregarious nature or potentially dangerous behaviour; elephants, primates and carnivores often attract a disproportionate level of blame (see Hill, 1997, Siex and Struhsaker, 1999, Knight, 2000a, Weladji and Tchamba, 2003, Jackson and Wangchuk, 2004, Kleiven *et al.*, 2004, Naughton-Treves and Treves, 2005). This can result in the persecution of wildlife (Lee and Priston, 2005) and erroneous crop protection that actually increases the density of detrimental agricultural 'pests' (Van Vuren and Smallwood, 1996); for example, the killing of the house crow in the Maldives appears to have resulted in severe damage to fruit trees by its prey, the longhorn beetle (Hunter, 1996).

The reasons for the disparity between actual and perceived loss are not always clear. Local people may simply misidentify the damaging species or misunderstand its relationship with domesticated crops; for example the Malaysian flying fox (*Pteropus vampyrus*) is a primary pollinator of the durian fruit and its close interaction with the plant means it is often perceived as a 'pest' (Salafsky, 1993). Alternatively, farmers may consciously inflate losses if there is any opportunity for compensation (Sekhar, 1998, Siex and Struhsaker, 1999, Plumptre, 2002, Priston, 2005). Furthermore, perceptions toward animals and human-wildlife conflict may not be a reflection of actual damage but rather a social tension or a symbolic threat (Knight, 1999, Hill *et al.*, 2002). For example, macaques in Palau symbolize local people's frustration with 'outsiders'; these animals were introduced to the island by foreigners who are now campaigning for their conservation (Wheatley *et al.*, 2002). Complaints regarding wildlife adjacent to protected areas can also reveal discontent with conservation legislation and subsequent limitations in access to resources (e.g. Parry and Campbell, 1992, Nepal and Weber, 1995). Clearly, it is important to understand not only how local people perceive the problem but also to explore factors that may influence their views.

Knowledge, ethnicity, religion, wealth and period of residency have all been reported to influence perceptions of wildlife (see Infield, 1988, Heinen, 1993, Zinn and Andelt, 1999, Knight, 2000a, Kleiven *et al.*, 2004, Priston, 2005). Proximity to animal habitat also influences opinions; those closest to forest or nest sites often have a negative view of wild species (Nepal and Weber, 1995, Zinn and Andelt, 1999). In addition, the ability of local people to manage 'problem animals' is believed to impact upon attitudes and perceptions (Newmark *et al.*, 1993, Naughton-Treves, 2001, Hill, 2004, Kleiven *et al.*, 2004). Indeed, research indicates that a lack of control and the uneven distribution of costs can increase the perception of risk (Slovic, 1987). Clearly there are many different factors that can affect views of wildlife and understanding the perceptions of animals is central to the development of effective mitigation strategies (Hill, 2005). Understandably, local people will not accept intervention unless it addresses issues that are viewed as paramount amongst the affected community (Quinn *et al.*, 2003). This necessitates a thorough knowledge of the social landscape, as seemingly extraneous factors can impact upon human-wildlife conflict; for example, complex land ownership issues contributed to the ineffectiveness of monetary compensation in southern India (Madhusudan, 2003). Understanding the views of local people will also encourage a more open and sympathetic dialogue between stakeholders (Conover and Decker, 1991, Loker *et al.*, 1999). This is vital in areas of human-wildlife conflict.

The aims of this chapter are:

- To explore local people's perceptions of crop raiding by primates and other large vertebrates, proportional to other issues

- To examine attitudes to all wildlife species utilizing human foods, in particular primates

- To ascertain if there is any difference in perceptions toward specific species and the reasons for variation in tolerance levels

## 6.2 Methods

Semi structured interviews (SSIs) were conducted from April to June 2004 (N=93) and August to November 2005 (N=76) at all the study sites. One adult representative from each farm was asked to take part and every effort was made to use the same individual for both interviews. Where this was not possible due to death, migration or availability (N=11), another member of the household was approached. Demographic information was recorded for all interviewees (N=104). Additional information was collected in seven focus groups (N=31) and during participant observation.

### *6.2.1 Semi Structured Interviews*

Two interview guides (Appendix 9) were prepared in order to frame the SSIs (Rossman and Rallis, 1998) and assist the researcher to remain focused on the research questions. This was particularly important in this study as I am a novice interviewer (Drever, 1995) and beginners in this research technique can be 'over-controlling', talk too much and not actively listen (Rossman and Rallis, 1998, Gilham, 2000, Bryman, 2001c). Inevitably, not paying attention to the responses of the participant can make it difficult to react with articulate and perceptive follow-up questions (Rossman and Rallis, 1998).

Both interview guides were split into three distinct sections, the first was concerned with informing the participant of the reason for the interview, the second the collection of demographic and socio-economic data and the third, the interview questions. It was important to include an introductory phase in order to explain the purpose of the discussion (Gilham, 2000), prevent misinterpretations and set the interview in the context of the study (Drever, 1995). In addition, the 'preamble' defined the expectations of both researcher and participant (Rossman and Rallis, 1998) and enabled clarification that the participant was willing to take part in the study (Hill, 1997). The first two sections were only included in the second interview for those who were new to the study.

The first interview began with an open, non-threatening question (Drever, 1995) to relax the participant, encourage them to begin to talk about their agricultural experiences and offer some general information regarding life in a rural, farming community. Subsequent questions were related to specific elements of the research project and were formulated to flow in a logical manner (Drever, 1995, Gilham, 2000, Bryman, 2001c). In the second SSI, the questions were much more focused as the research team and the participant were familiar with each other and the research project. However, it should be noted that both guides were not prescriptive and the order of questions was amended, where necessary, throughout the interview. Despite this flexibility, questions were distinct enough to allow for effective data analysis (Gilham, 2000).

The language used was clear, simple and relevant to the community (Drever, 1995, Bryman, 2001c). In addition, care was taken to avoid leading the interviewee, for example, questions did not begin with "do you ....." as it implies that the participant should either have an opinion on the subject or perform the activity (Drever, 1995, Bryman, 2001c). In order to assist the research team, both guides were formatted and developed with prompts alongside the questions (Drever, 1995, Gilham, 2000). Prompts were vital so I could exert a little control over the interview process and clarify the responses given by the participant (Drever, 1995). Probes are another important technique used in interviews to encourage the participant to elaborate their points (Drever, 1995, Rossman and Rallis, 1998), however, they can be a difficult skill to master (Gilham, 2000) especially for the inexperienced interviewer. For this study, I did not specifically use probes but reflected on the participant's statements (Gilham, 2000), using 'content paraphrases' or repetition of statements to clarify understanding and encourage further elaboration on the subject (Pretty *et al.*, 1995).

The last question in each guide was, again, general and open-ended to encourage the participant to offer any additional information (Drever, 1995) or to clarify what they believed to be the most important elements of the crop raiding issue. In both cases there was also a short summary section as it was important to tell interviewees about the conclusion of the study and plans for a final meeting.

The SSIs were undertaken individually with a translator. It was anticipated that this would allow community members to refuse more comfortably if they were not happy to take part in this stage of the research project. The interviews were conducted in farmers' fields or homes; a non-threatening, quiet location so that the participant was relaxed and the interview was unlikely to be affected by other local people (Drever, 1995, Gilham, 2000).

*6.2.2 Focus Groups*

The focus groups were each asked seven questions as outlined in Appendix 10. Direct questions were used in this study (rather than a topic guide) as the issues were well known to the research team and they allowed for a consistent approach in both delivery and the final analysis (Kreuger and Casey, 2000, Bryman, 2001b). The questions were piloted with the research team before they were used to ensure that they were completely understood and that there were no issues regarding accurate translation; questions needed to 'sound conversational' which can be difficult when working in another language, and be 'clear', 'short' and 'one dimensional' (Morgan, 1998, Kreuger and Casey, 2000), allowing no opportunity for mis-interpretation. As Kreuger and Casey (2000) discuss, the questions in the groups were designed to become more specific; beginning with open questions, moving to exercises on key themes and then concluding with closing questions.

Men and women were kept in separate groups to encourage open and honest discussion. Men are generally the dominant gender in rural Uganda and it was, therefore, important that women could express their views and opinions without fear of intimidation or retribution (Mitchell and Slim, 1991, Brown and Wyckoff-Baird, 1992). By separating the groups by gender and geographical location, the research was an example of stratified, 'double layer' design (Kreuger and Casey, 2000, Bryman, 2001b). The focus group sample knew one another due to the close proximity of their homes and/or farms; however, as in every community, some had closer relationships than others. Inevitably there are issues with using participants who know each other (Morgan, 1998, Bryman, 2001b) but it was hoped that through the randomization of the sample, potential bias was limited. It was important to emphasise to participants that they were randomly selected representatives of the study sample; I was very aware of the potential tension that could exist if other members of the community felt that they had been purposefully ignored in the selection process. In order to combat this, every study household was visited in the weeks leading up to the groups and the randomization process explained thoroughly.

The focus groups were held in the compound of one of the participating farmers. Village meetings would, traditionally, be held in the trading centre however, it was not felt appropriate to utilise this space due to potential disruption of the meeting. It was also acknowledged that farmers may feel more comfortable conducting the group in familiar surroundings, although it should be noted that 'there is no such thing as a neutral venue' (Bloor *et al.*, 2001, p 39) and social and political tensions exist in any environment.

The farmer hosting the meeting agreed to obtain firewood, water and extra chairs or mats. They were paid a small amount for the inconvenience (2,000 Ugandan shillings – just over $1 – and we also gave a small gift of a bar of soap and packet of salt as an extra thank you; every farmer went way beyond what we had agreed in terms of assistance). It was not felt to be appropriate to pay every participant and yet it was recognised that some form of incentive was important for this type of research due to the effort involved (Kreuger and Casey 2000); therefore, we supplied lunch (meat, rice and cabbage and a soft drink). It was hoped that this would be a good opportunity for further discussion outside the group (Kreuger and Casey 2000). Although it enabled informal conversation and laughter while preparing, little additional material was collected as in Ugandan culture it is impolite to talk while having a meal. All the food and drinks were obtained by the team, a local lady loaned large cooking pots (for which we gave soap as a gift), plates were supplied by a local church and a cook was employed to travel with us for four days to prepare the food. Although participants are used to lengthy village meetings, the focus groups were kept as short as possible to aid concentration (Pretty *et al.*, 1995). The local chairman was invited to each of the meetings however due to other commitments they were not able to attend. It is believed that this actually resulted in a more open dialogue with local farmers.

Within each study area, the two groups (male and female) were conducted in the same compound but at some distance apart and facilitated by one of the Ugandan members of the research team. The remaining member and I sat with each facilitator but not with any active role, merely to listen and take notes. Inevitably there were some concerns with regard to asking inexperienced moderators to facilitate. However, it worked well and supports the view that a person thoroughly engaged with all the research issues can collect data as well as a professional moderator (Morgan, 1998). The groups were seated in a small cluster with the facilitator, allowing an element of control but enabling participants to discuss issues amongst themselves (Chambers, 2002). Although circular/semi-circular groups are more commonly used in participatory research, they can be intimidating to some individuals (Pretty *et al.*, 1995, Chambers, 2002). The research team always sat on the same form of seating as the participants, mats, benches or chairs, to ensure that no one felt disempowered by the experience. All picture card sorting and drawing was done on the ground, a 'democratic' space that reduced unequal status among participants (Chambers, 2002).

*6.2.3 Risk Maps and Index*

To analyse the problems that local people state they have with their crops, risk maps were produced as per Smith *et al* (2000) and Quinn *et al* (2003). A severity index was calculated for each problem as follows, $Sj=1+(r-1)/(n-1)$, where r is the rank based on the order of response by the interviewee and n the total number of problems listed by that respondent (Quinn *et al.*, 2003). The mean distribution was calculated for all respondents who highlighted the issue and this created a score from 1 (most severe) to 2 (the least severe). An incidence index ($Ij$) was created to measure the proportion of respondents stating an issue; this score ranges from 0 (not mentioned) to 1 (mentioned by all). By dividing incidence by severity, a risk index was created ($Rj$); the higher this figure, the larger the perceived risk of the problem (Figures 6.1 and 6.2). Risk maps were also produced in order for the perceived and actual risk of each raiding species to be compared. A severity index was developed for each farm with crop damage; r was based on the rank of area damaged in each farm by species and n the total number of animals raiding in that farm. The incidence index reflects the proportion of farms experiencing crop damage by each species.

There are obvious limitations with risk mapping. For example, it works on the assumption that the first answer given is the one that respondents consider most severe. However, it is believed to provide a general indication of how the sample perceives risks to their farm.

## 6.3 Results

### *6.3.1 Perceptions of Crop Damage Proportional to Other Risks*

Interviewees (N=93) were asked to state all the problems that they experience on their farms in order to create a risk index:

**Table 6.1 Risk index of perceived problems experienced on farms per village. Bold figures denote the highest ranking issue and X indicates no response (N=159). Figures closest to 1 indicate those problems that are perceived as most significant.**

| | *Total Risk Index* | *Kyempunu Risk Index* | *Nyabyeya II Risk Index* | *Fundudolo Risk Index* | *Nyakafunjo Risk Index* |
|---|---|---|---|---|---|
| Crop Raiding* | **0.702** | **0.693** | **0.732** | **0.743** | **0.630** |
| Termites | 0.125 | 0.250 | 0.129 | 0.070 | 0.123 |
| Insects | 0.072 | 0.112 | 0.112 | 0.055 | 0.058 |
| Weather | 0.120 | 0.113 | 0.213 | 0.055 | 0.116 |
| Poor Soil | 0.062 | 0.083 | 0.112 | 0.035 | 0.023 |
| Weeds | 0.015 | X | X | 0.015 | X |
| Birds | 0.007 | 0.041 | X | X | X |
| Land Ownership | 0.006 | X | X | X | 0.015 |
| Lack of Land | 0.013 | X | X | 0.015 | 0.020 |
| Planting Strategies | 0.006 | X | X | X | 0.035 |
| Thieves** | 0.022 | X | X | 0.03 | 0.03 |

* When clarified, it became apparent that farmers used the term 'crop raiding' to discuss damage by wild, not domestic, species
** Included in this category are people who take food crops from farms and cane from plantations

Crop damage by wildlife has a much higher risk index than other problems. This is found in all villages, although slightly higher values are found in Nyabyeya II and Fundudolo (*Rj*=0.732 and 0.743 respectively). Termites and weather are also perceived to be a risk around BFR, particularly in Kyempunu (Termites *Rj*=0.250) and Nyabyeya II (Weather *Rj*=0.213). Of those who think crop raiding is the highest risk to their farms, the majority are wealthier with more than 4 indicators (67%, N=61). Seventy two percent of those who experience crop loss consider the utilization of food crops by animals to be their most significant problem (N=75).

A risk map overview was created (Figure 6.1) in order to graphically demonstrate the relationship between frequency and severity of response. Crop damage by wildlife stands apart from any other perceived risk in this area as it has a high severity index

($S$=1.103) and the highest incidence index of all issues ($I$=0.775). Thieves score highly on the severity index ($S$=1) but only a small number of farmers perceive them to be a problem ($I$=0.022).

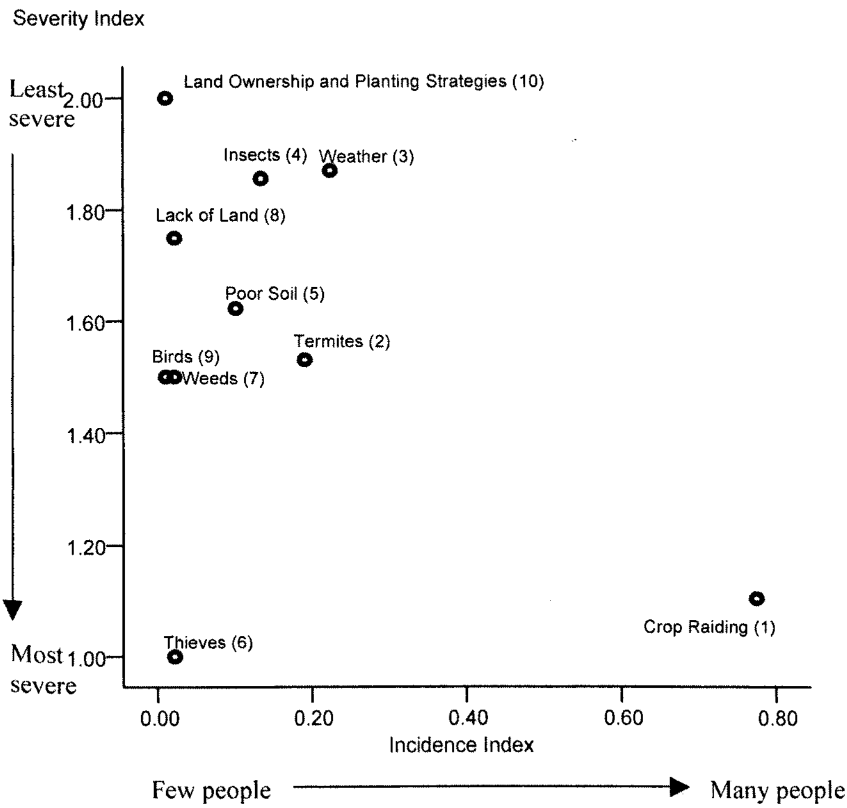


**Figure 6.1 Risk map overview depicting crop raiding proportional to other risks (N=159). The severity index is measured from 1 (most severe) to 2 (least severe). Risk index rank is added in parenthesis.**

Focus group discussion supports these findings and crop raiding is considered the primary factor that people would like to change about their environment (Table 6.2). Farmers state that "we keep complaining to the government and they promise [to help] but nothing is ever seen". However, crop damage is not the only perceived problem around BFR; disease/ sickness, famine and lack of land also rank highly.

Many local people state that disease/ sickness is a significant issue and that, without suitable medicine and finances, they are powerless to deal with the problem. The primary causes of illness are believed to originate in the forest; mosquitoes (*Anopheles* *sp*) and blackflies (*Simulium neavei*) as vectors for malaria and onchocerciasis (river blindness) respectively[39]. "Coldness from the forest" is also believed to cause influenza and malaria.

**Table 6.2 Focus group rankings of factors that local people would most like to change about their environment (N=31). Bold figures indicate the highest rank for that category.**

| | Total | Kyempunu | Nyabyeya II | | Fundudolo | | Nyakafunjo | |
|---|---|---|---|---|---|---|---|---|
| | | *Men* | *Men* | *Women* | *Men* | *Women* | *Men* | *Women* |
| Crop Raiding | **1** | 2 | **1** | **1** | 3 | 2 | 2 | **1** |
| Lack of Land | 4 | 3 | 2 | 2 | 3 | 4 | | |
| Lack of Money | 8 | | | | | | **1** | |
| Disease/ Sickness | 2 | 4 | 4 | **1** | **1** | **1** | | 3 |
| Famine | 3 | | | 3 | 2 | 2 | **1** | 4 |
| Lack of Jobs | 6 | | 3 | 3 | | 4 | 3 | 5 |
| Lack of Access to Forest Resources | 5 | | 3 | 4 | 3 | | 4 | 2 |
| Poor farming methods | 11 | | 4 | | | | | |
| Lack of Education | 10 | | 2 | | | | | |
| Cassava mosaic | 9 | 5 | | | | 3 | 5 | |
| Termites | 7 | **1** | | | | | | |

Lack of land is also perceived to be a problem at the study site. It is ranked as an important environmental factor in the majority of groups and appears to be a significant issue in Nyabyeya II. Although farmers in Nyakafunjo do not specifically refer to lack of land as a factor they would like to change about their environment, it is discussed as an important concern for local people. A number of farmers state that their land is owned by the NFA and that there is "always fear that they will come". Lack of access to forest resources is also cited as a problem by the majority of groups (n=5). These participants state that they cannot enter the forest without permits or they will be arrested. Many local people also discussed how outsiders are readily given permission to remove timbers but those living locally to the forest are denied access; "we gain nothing from the forest, people very far are gaining as they get permission for timber, those from here try and are refused".

[39] Malaria is caused by a parasite (*Plasmodium* sp.) which is transmitted to humans through a bite from an infected female mosquito. It can cause high fever, anaemia and death (Bell, 1981). River blindness is transmitted in a similar way; a bite from an infected black fly spreads the *Onchocerca volvulus* parasite. This can cause skin disease and blindness (Bell, 1981).

Focus group discussion was used to further understand the perceived relationship between local people and the forest. When asked who owned the forest, all groups conclude that the government has control and ownership of this resource. However, this is perceived to be a recent development, "before education the forest belonged to us all but, now its value is seen, it is owned by the Government". Indeed, for all of the women's groups and one of the men's, the initial response to this question is that the forest is owned by God. It is only when local people consider the restrictions placed on them regarding their use of the forest that they state that the government must have ownership.

Group discussion also indicates how many problems are intrinsically linked with one another. For example, lack of land is given as a reason for planting crops next to the forest edge. Land shortages force local people to utilize high risk planting strategies especially if other areas of the farm have become exhausted from intensive agricultural utilization; soil fertility is perceived to be better at the forest margin. Farmers are aware of the increased risk of crop damage by wildlife through this practice although, surprisingly, many consider it prudent to plant maize in these areas. They state that as a seasonal crop, maize is only vulnerable for short periods of the year and guarding intensity can be increased accordingly. Farmers state that if cassava were grown at the forest edge rather than closer to the house it would require guarding for eighteen months or more which is beyond the capabilities of the average household. Participants also discuss that crop raiding can lead to famine, sickness and a lack of education due the reduction in food supply and income. In addition, village development can slow as the community becomes poorer.

### *6.3.2 Perceptions of Risks over Time*

Crop damage by wildlife is not the only issue that local people perceive to be a problem and it is important to understand whether farmers believe crop damage is getting worse proportional to other risks. Therefore, interviewees were asked if key problem factors and resources had changed over time (Table 6.3).

Although the sample size is too small to analyse statistically (chi-square), there are some differences in distribution across the sample; 97% of interviewees (N=76) believe that sickness and disease has increased since their arrival at the site. Again, malaria and influenza are considered to be a significant part of this perceived rise along with stomach problems (including diarrhoea and ulcers), AIDS and epilepsy. Water sources and crop damage are believed to have remained consistent for many of the sample (82.8%, N=76 and 45.1%, N=93). In contrast, 67.1% of farmers believe that firewood abundance has decreased in the area and that people have to travel further to collect this valuable resource (N=76). One person stated that this was due to NFA refusing them admission to the forest reserve. Access to firewood is perceived differently by gender; 80% of women (N=35) believed it has decreased, in contrast with only 56% of men (N=41).

**Table 6.3 Perceived changes to social and environmental factors around Budongo Forest Reserve ([a]N=76, [b]N=75, [c]N=74). Bold figures indicate the highest ranking category. *N=93 as asked in first interview (2004).**

| | Increase | Decrease | Same | Don't Know |
|---|---|---|---|---|
| Land Availability[a] | 5 | 28 | **43** | 0 |
| Soil Quality[a] | 10 | **48** | 16 | 2 |
| Tree Cover[a] | 12 | **53** | 11 | 0 |
| Water[a] | 1 | 12 | **63** | 0 |
| Firewood[a] | 6 | **51** | 19 | 0 |
| Sickness[a] | **74** | 2 | 0 | 0 |
| Education[b] | **58** | 15 | 2 | 0 |
| Employment[c] | 18 | **54** | 2 | 0 |
| Animal Density[a] | **59** | 15 | 0 | 2 |
| Crop Disease[a] | **71** | 3 | 2 | 0 |
| Crop Damage* | 10 | 2 | **42** | 39 |

The majority of the sample also believes that tree cover has decreased in the area. This is particularly obvious in certain villages; 83% (N=12) of farmers in Kyempunu believe there are fewer trees now compared to when they arrived at the site. However, in Nyakafuno, 25% (N=28) of local people believe tree cover is increasing. This is unexpected given the widespread pit-sawing and deforestation present in Nyabyeya parish. However, this perceived increase may be due to the close proximity of Budongo Saw Mill; since its closure, there has been notable regeneration around the mill and its redundant logging roads. A number of farmers state that fruit trees are now common in Nyakafunjo.

Seventy seven percent of the sample believes that animal density has increased (N=76). This is predominately regarding problem species such as baboons, monkeys and bush pig. However, some individuals believe that chimpanzee numbers are also increasing. One of the reasons given for the perceived rise in density of problem wildlife is that local people are restricted from using effective crop protection techniques. As one elderly farmer lamented, "if you kill a baboon you will be charged, if you throw a stone at a chimpanzee you will be charged, if you put wires [snares] in the forest you will be arrested". In addition, local people state that Uganda Wildlife Authority (UWA) now only scare problem animals where as past policy was to eradicate them. Many farmers cannot see a solution under the current conditions; "there is no end, the animals are still producing and we are still here". However, 19.7% of interviewees believe that animal density is decreasing. It is noticeable that declining species are traditional game animals (i.e. bushbuck, antelope and bush duiker), not those considered to be 'pests'. There is a mixed response regarding changes in animal density when analysed by gender; 91.4% of women (N=35) believe wildlife numbers have increased but only 65.8% of men (N=41). There is no difference in the distribution of perceived animal density by exposure to raids.

The majority of the sample (56.5%, N=76) believes that land availability has remained the same since they arrived in the area. However, 36.8% of individuals state that the amount of land available to them has fallen. This perception appears connected to forest proximity and traditional distribution of land, for example one farmer stated that "when father came from West Nile he had many children...land is divided but we cannot extend further due to the forest". Local people also state that forest officials are increasing the reserve boundary thus making it difficult to maintain or increase the size of farms.

Other perceived problems include a lack of employment and 72% of respondents (N=74) state that job opportunities have decreased since their arrival at the site. Some farmers also note that an increase in education levels in the area has resulted in a lack of employment; even unskilled positions now require proof of schooling. Furthermore, corruption is believed to be rife and many examples of nepotism were given regarding the limited job opportunities. The forest itself is also believed to prevent employment in the area; a number of farmers state, "it is not easy to get work here, as we can't be employed in the forest", "we are living where people should not live...a nature reserve...better if more businesses to bring in more income so people are not dependent on farming". Sixty six percent of those who believe employment has decreased (N=54) are moderately wealthy with four or more wealth indicators.

### *6.3.3 Perceived Benefits of Budongo Forest Reserve*

Interviews and focus group discussions reveal that local people believe they are exposed to unique problems as a consequence of living near forest habitat. It was therefore important to assess if they perceived any benefits from dwelling next to BFR:

**Table 6.4 Perceived benefits of the forest (N=76, many farmers gave multiple responses)**

| Benefit | Frequency |
|---|---|
| *Basic Needs* | *178* |
| Poles | 35 |
| Ropes | 9 |
| Firewood | 59 |
| Water | 51 |
| Oxygen | 2 |
| Food (incl. greens and mushrooms) | 8 |
| Medicine | 12 |
| Clay (for water carrying vessels | 2 |
| | |
| *Economic Needs* | *23* |
| Timber | 18 |
| Rattan | 2 |
| Charcoal | 1 |
| Employment | 2 |
| | |
| *Other* | *14* |
| Rain Attraction | 9 |
| Wind Break | 1 |
| Animal Habitat | 1 |
| Seeds | 1 |
| Craft Materials | 1 |
| No Benefit | 1 |
| **Total** | 215 |

There is a significant difference in the distribution of responses when they are categorized into basic needs, economic needs and other ($\chi^2$=237.3, df=2, p<0.01). It should be noted that there is the potential for overlap between categories, for example poles can be sold in the market and rattan and charcoal can be used for household use. However, personal observation of the most common usage assisted category definition and this classification provides a general indication of the perceived value of forests in this area. The majority of perceived benefits (82.7%) are with regard to basic human needs such as food, shelter (poles are used to construct traditional dwellings in this area), water and fire (N=215). Economic needs are also important and 10.6% of responses refer to the supply of timber and other resources. There is very little variation in response when categorized by demographic variables.

Interviewees were also asked to list the benefits of wildlife (Table 6.5) and there is a significant difference in the distribution of responses ($\chi^2$=120.54, df=6, p<0.01). The majority of the sample (61.8%) believe meat is an important benefit of wildlife around BFR (N=76). Not only is it used for household consumption but it can also be sold in markets[40]. Although farmers recognize that it is illegal to hunt wild animals, there is the belief that this legislation only applies to specific species. For example, many local people discuss that duiker are legitimate quarry.

Animal skins are an important benefit for a small number of respondents (n=5) as they can be used as mats and in traditional dances[41]. Chimpanzees are often referred to in discussions about the benefits of wildlife; for example, statements regarding tourism, medical research (the testing of new drugs before they are tried on humans) and money for the government all concern these animals. In addition, the one respondent who

[40] Although the sale of bush meat was not observed around BFR, a market in Hoima (approximately 50km from the research area) is understood to trade in wildlife meat, including primates. A recent survey by UWA has also indicated that bush meat from this area is being sold in Kampala (Tenywa, 2005). In addition, KSWL employ a hunter who in 1997 had a market for approximately 200 carcasses a month (Paterson, 2005). Respondents discussed how private transactions between households are more likely at this study site.

[41] Tails of black and white colobus were observed being used by dancers at a local wedding. However, this was unusual and participant observation suggests that the traditional use of animal body parts (i.e. skins and skulls) is not often practiced in this area.

believes conservation/ development initiatives are a benefit was discussing BFP's support of community projects e.g. well protection.

**Table 6.5 Perceived benefits of wildlife (N=76, some farmers gave multiple responses)**

| Benefit | Frequency |
|---|---|
| Meat | 47 |
| No Benefit | 13 |
| Medical Research | 8 |
| Animal Skin | 5 |
| Tourism | 6 |
| Seed Dispersal | 3 |
| Other (Incl. conservation/development projects, crop guards* and money for government) | 4 |
| **Total** | 86 |

* This refers only to chimpanzees; the respondent stated that other animals do not enter if they are in the field

Although it is not possible to analyse statistical differences due to small sample size (chi-square), there is some variation at the demographic level. Both men and women state that meat is an important benefit of wildlife at this site, however only men perceive that tourism could also be beneficial to local communities. The majority of those who believe there is 'no benefit' from wildlife live in Nyakafunjo (n=7).

### *6.3.4 Perceptions of Specific Raiding Species*

Farmers were asked to list the animals that they find most problematic in their farms. These data are considered alongside a risk index of actual loss (species are ranked by the actual damage they cause in each farm). Only animal species that have a perceived and actual value are included here (Table 6.6).

Baboons are considered the most problematic species around BFR as they have both a high perceived severity and incidence index. Bush pigs are also mentioned by many interviewees as a problem but they are regarded as less of an issue than other animals. A small number of respondents perceive monkeys to be a moderate risk and bush duiker to be a severe problem. Goats and chimpanzees are also considered a moderate risk but by few interviewees.

**Table 6.6 Actual and perceived risk index for key raiding species (actual area of damage, N=98 farms; perceived problem species, N=132). + indicates the highest factor (i.e. A=actual or P=perceived risk). Severity index measured from 1 (most severe) to 2 (least severe) and incidence from 0 to 1 (most reported).**

| Species | Perceived Severity Index | Actual Severity Index | Variance | Perceived Incidence Index | Actual Incidence Index | Variance |
|---|---|---|---|---|---|---|
| Baboon | 1.17 | 1.24 | +P | 0.54 | 0.37 | +P |
| Bush Pig | 1.70 | 1.48 | +A | 0.39 | 0.29 | +P |
| Monkey | 1.43 | 1.65* | +P | 0.17 | 0.26* | +A |
| Bush Duiker | 1.16 | 1.46 | +P | 0.08 | 0.13 | +A |
| Goat | 1.50 | 1.24 | +A | 0.07 | 0.59 | +A |
| Chimpanzee | 1.50 | 1.63* | +P | 0.03 | 0.02* | +P |

*Actual severity and incidence indexes are conservative for chimpanzee and monkey due to fruit and sugar cane not being included in estimates of damage area

Graphical representation highlights that there are a number of key differences between actual and perceived risk for each species (Figure 6.2).

For baboons, perceived severity and incidence indexes are higher than actual risk. This suggests that local people believe baboons are a greater problem than analysis of actual damage (proportional to other raiding species) demonstrates. Goats have the most significant variation between actual and perceived risk; area damaged and the number of farms experiencing damage to this species is proportionally much higher than local people believe. Monkeys and bush duiker also have a higher rate of actual rather than perceived incidence but for severity the results are reversed, perceptions of loss are greater than observed crop damage, proportional to other species. Surprisingly, for bush pig perceptions of severity are not as high as actual damage, although perceived incidence is greater than actual frequency. This suggests that bush pig damage a smaller proportion of farms than is suggested, however they are responsible for a greater than anticipated level of crop loss. If actual loss to chimpanzees is indeed under-represented in this study, actual and perceived risk appears very similar for this species.

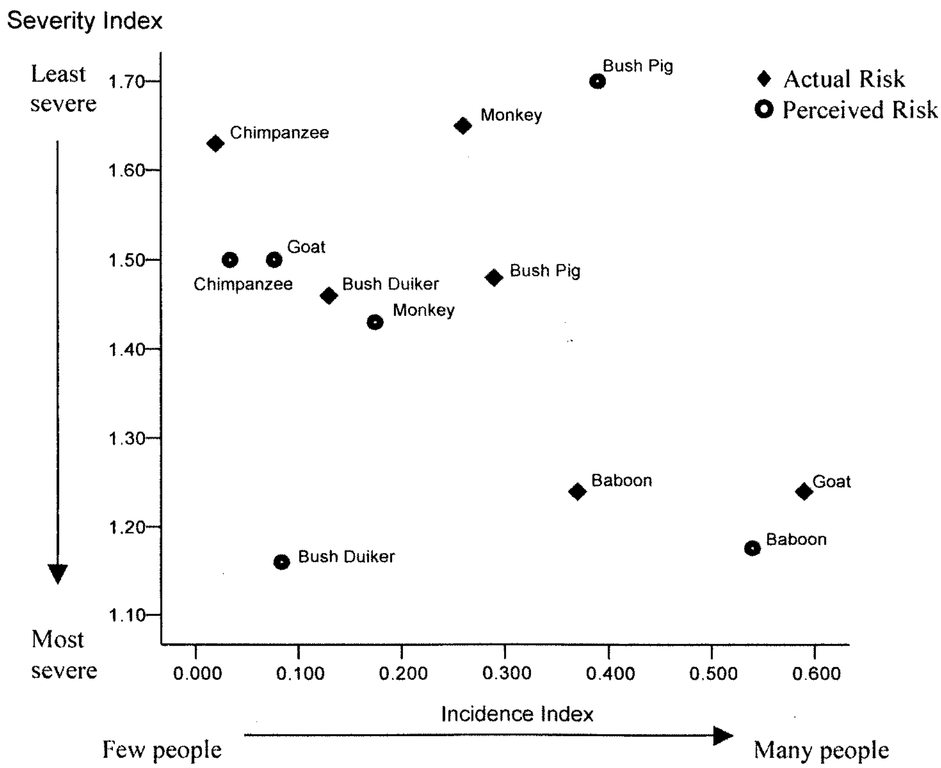


**Figure 6.2 Risk map overview depicting perceptions of problem animals (N=132) and actual damage by those species (N=98). Severity is measured from 1 (most severe) to 2 (least severe).**

In order to understand the relationship between actual and perceived risk it is important to explore the attitudes of local people toward specific animals. Therefore, interviewees were asked to give one word to describe different raiding animals (see Table 6.7 for ranked categories) and these are grouped into positive, negative and neutral statements. Neutral is used to describe words with no emotive charge (i.e. farmer's responsibility) or that can embody both negative and positive values; for example, 'human' is used often to describe chimpanzees.

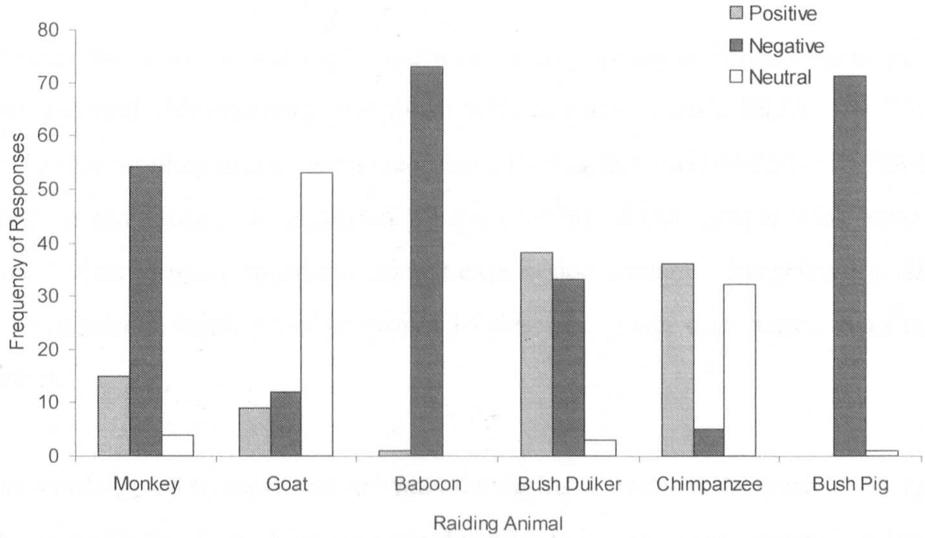


**Figure 6.3 Positive, negative and neutral responses given for species causing damage at the site (N=440)**

There is a statistical difference in the distribution of responses for each species (monkey $\chi^2$=56.7, df=2, p<0.01; goat $\chi^2$=49, df=2, p<0.01; baboon $\chi^2$=70.05, df=1, p<0.01; bush duiker $\chi^2$=29.05, df=2, p<0.01; chimpanzee $\chi^2$=23.3, df=2, p<0.01 and bush pig $\chi^2$=68.05, df=1, p<0.01). Statements are particularly negative for baboon and bush pig (both 98.6%, N=74 & 72 respectively). In contrast, 49.3% of the words selected for chimpanzees are positive and 43.8% are neutral (N=73). Goats also get a high proportion of neutral statements (71.6%, N=74). Bush Duiker receive a mixed response, 51.3% chose positive words, whilst 44.5% selected negative statements (N=74).

There is some demographic variation regarding perceptions; for example, all of those farming within 250m of forest perceive baboons and bush pig negatively (n=63 and 61 respectively). Interestingly, a high proportion of this group did not experience damage; 65.2% (N=72) of those with negative views about baboons and 72.8% (N=70) about bush pig cultivate in farms that did not have evidence of crop loss to these species. This result was also found with bush duiker; only 15.7% (N=38) of those with negative views were actually raided by this species during this study.

Distance from forest and raid experience also appears to impact upon perceptions of monkeys and chimpanzees. Of those with negative views, 88.6% (N=53) and 100% (N=5) (for monkey and chimpanzee respectively) farm within 250m of forest, degraded forest or plantation. In addition, 89.4% (N=19) of the sample who have positive or neutral views toward monkeys do not experience damage. Surprisingly, 88.8% (N=9) of respondents using positive words to describe goats experience crop raids by this species.

The words given to represent animals damaging human foods were also organized into categories (Table 6.7). Many people describe baboons as the 'enemy', using words like 'rebel' and 'Kony'.[42] They are perceived to be highly destructive and have negative character traits; 'glutton', 'arrogant' and 'stubborn' are all used to describe baboons. A small number of respondents summarized that they were 'dangerous' and 'aggressive'. Only one person described baboons as clever.

**Table 6.7 Top five category responses of local people to specific raiding species (N=440)**

| Rank | Baboon | Bush Pig | Monkey | Goat | Bush Duiker | Chimpanzee |
|---|---|---|---|---|---|---|
| 1 | Enemy | Destroyer | Thief | Farmer's responsibility | Thief | Human |
| 2 | Destroyer | Thief | Clever | Good character | Good character | Good character |
| 3 | Bad character | Enemy | Destroyer | Prisoner | Enemy | Destroyer |
| 4 | Thief | Dangerous | Good character | Thief | Clever | Bad character |
| 5 | Dangerous | Bad character | Bad character | Little destroyer | Wizard | Guard |

Responses for bush pig are very similar to baboon; bush pigs are also described as the enemy but to a lesser extent. The highest ranking category for this species is

[42] Joseph Kony is the leader of the Lords Resistance Army (LRA), a rebel group that has been active in northern Uganda for eighteen years. The LRA are responsible for the displacement of an estimated 1.5 million people (BBC News 2006a)

'destroyer' and words such as 'grader', 'sweeper' and 'tractor' describe the manner in which bush pigs raid farms. They are also described as 'greedy' and 'gluttonous'. In addition, bush pigs are strongly associated with their nocturnal lifestyle; 'thief' is not used in just a conventional context but because people who steal in Uganda are believed to be active during the hours of darkness. Two people used the word 'wizard' to describe bush pig as night is associated with magic and spirits. Although words for baboons and bush pigs are overwhelmingly negative, monkeys, chimpanzees and bush duiker receive a more mixed response.

The highest ranking category for monkeys is 'thief' and they are described as "peeping" and "hiding" in vegetation as a criminal would do if caught at the crime. A number of interviewees physically demonstrated the way monkeys run and hide from view in maize or fruit trees. It is this behaviour that appears to influence the perceptions of those who state monkeys are "clever" or have "good character". Indeed, the words chosen are extremely positive considering many farmers were referring to crop damage experiences; monkeys are described as "faithful", "honest" and "consistent". However it should not be overlooked that monkeys were also categorized as "destroyer" and "bad character" due to their consumption of food crops, and two people stated that they were 'dangerous'.

Words chosen to describe bush duiker are also mixed; interviewee's categorical responses range from "good character" and "clever" to "enemy". Like bush pig, many words are chosen to describe their nocturnal feeding habits; "thief" and "wizard" are both used in this context. Bush duiker are also regarded as intelligent because they are "fast", "difficult to trap" and "selective" in the crops that they damage. They are also considered "brave" and "respectful".

Chimpanzees are categorized by the majority of respondents as "human". In addition, they are described with many words that befit valued members of human society; "friendly", "humble" and "respectful" were all used to describe this species. It became clear that often this perspective was due to chimpanzee movement and raiding behaviour. They are considered to "walk gently" and be "disciplined" in their crop damage, only removing as many food items as they need. However, this exercise also reveals an element of fear of chimpanzees and a number of people use oxymoronic language to describe them; "friendly but dangerous" and "good but arrogant". Several women regard them as the "boss", which suggests that they are respected but avoided due to their strength. Interestingly, the only time chimpanzees are considered "destroyers" is if the interviewee is discussing sugar cane.

Goats are summarized in a very different way to wild species and many words used reflect the influence of the owner of the animal as opposed to raiding behavior; they are described as "home property" and the "farmer's responsibility". A number of local people summarize them as a "prisoner", tied and controlled by their owner. In addition, one person described them as a "child", requiring guidance and not to be held responsible for their own actions. Whilst some refer to their capacity for crop raids, goats are considered a much lesser threat than that of wild species (i.e. "little destroyer") and the result of negligence on the part of the owner. One individual emphasized their cultural value by stating that goats are a "savings account". In an effort to understand why people hold these perceptions of raiding species, farmers were asked the type of crops that each species raids (Table 6.8).

Maize is reported to be damaged by the most animals; baboon, bush pig, monkey, goat and bush duiker were all believed to eat the crop. Cassava is also believed to be consumed by baboon, bush pig and bush duiker. Yam, millet and Irish potatoes are only perceived to be damaged by bush pig. Baboon and bush pig are believed to damage a high number of food crops, although only with baboon was the highest ranking category that of 'all' crops. A high proportion of local people state that baboons are not selective in their raids; many farmers discussed how "baboons will take anything", "baboons will destroy even what they do not eat" and that they "come just to spoil not to eat". Local people also discuss how baboons will take chickens from farms. This is in contrast to chimpanzees and goats that are both perceived to damage few types of crop.

**Table 6.8 Ranks of perceived crop preferences by raiding species (N=163, bold figures indicate highest ranking crop for that species)**

| Crop | Mean Total Rank | Baboon | Bush Pig | Monkey | Goat | Bush Duiker | Chimpanzee |
|---|---|---|---|---|---|---|---|
| All | 2.3 | **1** | 3 | 3 | | | |
| Maize | **1.8** | 2 | 2 | **1** | **1** | 3 | |
| Cassava | 2 | 3 | **1** | | | 2 | |
| Sweet Potato | 4 | | 5 | | | 3 | |
| Beans | 2.6 | 5 | | 2 | | **1** | |
| Fruit | 2.3 | 4 | | 2 | | | **1** |
| Tobacco | 6 | 6 | | | | | |
| Sugar Cane | 4 | 6 | | | | | 2 |
| Ground Nut | 5 | 6 | 6 | | | 3 | |
| Yam | 4 | | 4 | | | | |
| Millet | 6 | | 6 | | | | |
| Irish potato | 7 | | 7 | | | | |

At the height of raiding activity, local people report that monkeys, chimpanzees and bush duiker visit farms on a daily basis. However, more variable responses are given for baboon and bush pig. For these species, accounts range from daily and several times a week to once a week or once a month depending on crop maturity and the rains; bush pig raids are linked to the presence of rainfall. As one farmer stated, "they [baboon and bush pig] do not have times, maybe they don't disturb all week and then they can be destroying all the time, especially if the crop is mature".

Clearly local people believe that raiding species differ in their feeding behaviour and this could influence perceptions. However, it is also important to understand if there is any difference in the perceived value of specific crops (Table 6.9). There is a significant difference in the distribution of responses regarding crop importance around BFR ($\chi^2$=33, df=5, $p<0.01$). Economic gain is the most significant factor (unstandardized residual = +17) as crops can be sold to buy essential household items such as salt and soap. These include maize and millet in addition to more conventional cash crops such as tobacco and sugar cane.

**Table 6.9 Most important crops and the reasons for their selection (N=83)**

| | Money | Food | Money & Food | Advantage in Field [a] | Advantage in Kitchen [b] | Cultural | **Total** |
|---|---|---|---|---|---|---|---|
| *Food Crops* | | | | | | | |
| Maize | 14 | 7 | 9 | 2 | 0 | 1 | 33 |
| Cassava | 1 | 5 | 5 | 6 | 4 | 0 | 21 |
| Millet | 3 | 0 | 0 | 0 | 8 | 1 | 12 |
| Ground Nuts | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| Beans | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| Rice | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sweet Potato | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Yam | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Banana | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| *Cash Crops* | | | | | | | |
| Tobacco | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| Sugar Cane | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| **Total** | 31 | 12 | 14 | 9 | 15 | 2 | 83 |

[a] Advantage in field includes qualities such as hardy, long lasting, easy to maintain and grows well
[b] Advantage in kitchen includes qualities such as tastes good, satisfies, stores well and easy to prepare

Perceptions of most important crop are also distributed differently ($\chi^2$=82.58, df=7, $p<0.01$); maize and cassava are believed to be the most significant crops grown in this area by 39.7% and 25% of the sample respectively (N=83). For maize, this is due to its ability to bring money and food to the household. Cassava also has importance as a source of economic gain and sustenance but it also has advantages in the field and kitchen; cassava is considered hardy, can survive a long time in the ground and is easy to prepare. Millet is also believed to be important because it can be stored for a long time without perishing.

*6.3.5 Crop Protection Strategies by Species*

In season three, interviewees were asked which methods of crop protection they would like to use for each of the key raiding species should there be no legal restrictions (Figure 6.4). The categories were: A - barrier method (i.e. stop the animal from entering the field), B – repellant (i.e. remove the animal when in field), C – eradication (i.e. kill the animal) in addition to 'none' and don't know':

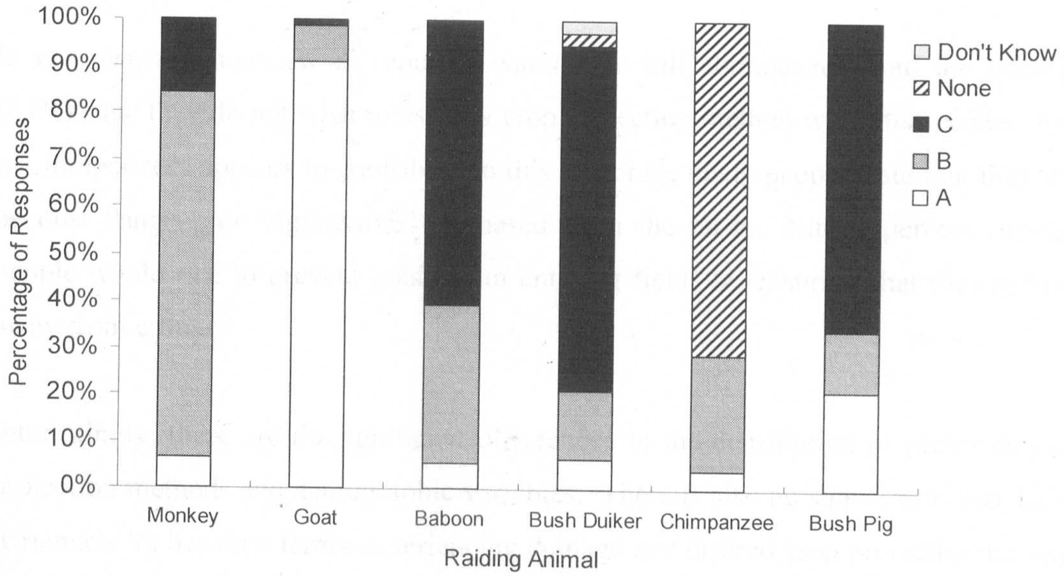


**Figure 6.4 Graph depicting acceptable crop protection strategies for dealing with specific raiding species (N=76)**

Desired crop protection methods are statistically different for each raiding species (Monkey $\chi^2$=68.07, df=2, p<0.01; Goat $\chi^2$=113.39, df=2, p<0.01; Baboon $\chi^2$=34.84, df=2, p<0.01; bush duiker $\chi^2$=140.44, df=4, p<0.01; Chimpanzee $\chi^2$=53.71, df=2, p<0.01, bush pig $\chi^2$=36.73, df=2, p<0.01). For example, the majority of farmers (77.6%) wish to chase monkeys from farms (N=76). Few want to kill or use barrier methods against these species. However, the preferred method of crop protection for baboons, bush duiker and bush pig is eradication; 60.5%, 73.6% and 65.7% state that they wish to kill these species with traps, poison or snares. Although dogs and catapults are given as examples of methods to remove baboons from farms, killing is preferred to other techniques; as one farmer stated, "chasing is useless as they see you from afar". Some women who state that they wish to kill baboons feel restricted from doing so due to their limited body strength and fear of the animal.

Bush pig are regarded as 'dangerous' and one farmer declared that you 'have to kill bush pig or it may kill you first'. Another reason for wanting to kill baboon, bush pig and bush duiker is to gain meat in addition to protecting crops. Whilst many do not eat primates, farmers stated that baboons and monkey carcasses can be sold in markets.

In contrast, no interviewees reported wanting to kill chimpanzees and the majority (73%) state they do not wish to use any crop protection method with this species. Fear of chimpanzees appears to contribute to this response; many people state that they will become "angry" or "aggressive" if chased from the farm. Ninety percent of local people would like to prevent goats from entering fields by ensuring that they are tied away from crops.

Interestingly, there are no significant differences in the distribution of preferred crop protection methods and demographic variables. There is also no significant association (Cramer's V) between farms experiencing damage and desired crop protection for each species, however, there is some variation in distribution. A high proportion of those who advocate the killing of raiding animals did not experience raids by that species during this study; 91.6% for monkeys (N=12), 83.9% for bush duiker (N=56), 68% for bush pig (N=50) and 60.8% for baboon (N=46).

## 6.4 Discussion

Farmers around BFR perceive crop damage by wildlife to be a much more significant risk than other limiting factors. This is due to its embodiment as an external issue and its relationship with other debilitating factors at the site. Perceptions of specific raiding species are also heavily influenced by social values; views of animals reflect elements of human society and indicate behaviours that will/ will not be tolerated by the local community. This is particularly apparent in local people's descriptions of primate species.

### *6.4.1 Perceptions of Crop Damage Proportional to Other Risks*

Crop damage by wildlife is one of many problems that local people state they experience on their farms or in their environment; insects, sickness, the weather and lack of land are all believed to impact negatively on rural livelihoods. One surprising omission is access to clean water as the entire sample is dependent upon local streams for drinking, cooking and washing. However, many of the streams in this area are protected and could therefore be considered 'clean' and 'safe'[43].

Not all farmers believe they are exposed to the same levels of risk and this may reflect intra-site variation. For example, those in Kyempunu perceive termites to be a significant problem. A high proportion of farms in this area do have evidence of stem damage (Chapter 5) and it was the only site where local people were observed using banana leaves as building material (walls) to avoid termite infestation. In addition, farmers living in Fundudolo frequently refer to sickness as a persistent issue and many speak of the threat of onchocerciasis. 'River blindness' is a particular risk to those who work or live near fast-flowing streams (Etya'ale, 2002)[44] and previous research has indicated that villages in this area are disproportionally affected by the disease (Sutton

[43] Natural water sources are protected in Uganda by building a retaining wall around the spring. A pipe is then installed to assist local people to draw water whilst protecting the spring from pollutants. (Thornton, 1998). Any Ugandan household living close to this system is defined as having access to safe water in government policy documents (UBOS 2005).

[44] The black fly breeds in these conditions. It should be noted that individuals displaying symptoms of onchocerciasis were seldom observed during this study; however this could be due to an extensive Ugandan government programme that distributes *Ivermectin* to try and combat the disease (Uganda Ministry of Health 2006a).

*et al.*, 1995). There is also a high incidence of epilepsy around Fundudolo (Sutton *et al.*, 1995, *pers obs*) and there is a possible link between the two conditions (Etya'ale, 2002). In these cases, perceptions appear to reflect the uneven distribution of actual risk across the study sample.

Despite the existence of numerous issues, crop damage by wildlife is considered more significant both in the severity and frequency of farms affected. It is also the main factor that local people would like to change about their environment. This high perceived risk may reflect farmers' knowledge of the research study as all interviewees knew the topic of interest and may have inflated responses accordingly. However, participant observation with local people outside the study area indicates that this is a representative response. It is, therefore, important to understand why crop raiding is perceived differently to other problems.

6.4.1.1 Crop Damage as an External Issue

Crop raiding by large vertebrates, like damage from termites, birds, thieves and the weather, can be defined as an 'external' agricultural issue, an outside influence that physically enters and manipulates the agricultural domain. In contrast, soil fertility, planting strategies and farming methods are 'internal' problems that originate and proliferate from within the farm boundary. In this study, external agricultural issues are perceived as more severe than those which are internal to the farm. This bias has also been seen in other research around BFR; Tweheyo *et al* (2005) found that poor sowing and fire (which is usually started by the farmer from within the field) were considered to be less significant than wildlife, drought and insects.

One of the most pervasive determinants of a high perception of risk is if the threat is believed to be external to the community (Fitchen *et al.*, 1987). This has been found at other sites of conflict; jaguars were perceived to be a problem in Brazil because farmers believed, incorrectly, that they were being introduced to the forest (Conforti and de Azevedo, 2003). There is little evidence to suggest that internal issues are actually less damaging to agricultural crop yields, indeed weeds[45] are not considered to be a problem by any of the study sample and yet they are reported to be the highest potential source of loss to maize globally (Oerke and Dehne, 2004). 'Poor soil' or reduced soil fertility is also known to have a serious and significant impact upon crop development and subsequent harvest (Yayock *et al.*, 1988).

The heightened level of risk regarding damage by wildlife may be due to the fact that external agricultural problems are more difficult for the farmer to control than internal issues. For example, the density of problem animals is believed to be rising around BFR[46] and local people wish to eradicate those animals considered to do the most damage (i.e. baboons and bush pig)[47]. By killing problem species, local people not only reduce the risk of crop loss, they are also 'compensated' for any damage that they may sustain in the agricultural season (Vansina, 1990). Meat is perceived to be the main benefit of wildlife in this area as it can supply valuable protein, has an important role in local celebrations (Johnson, 1996) and can be sold to earn extra money for the household. Therefore, local people are frustrated that they are not allowed to actively hunt 'vermin' species and do not believe that UWA are taking responsibility for the situation. It is interesting to note that some respondents believe traditional game species are declining in this area. This suggests that either duiker, antelope and bushbuck have not recovered from colonial management policies (Chapter 2) or they have been harvested unsustainably despite the ban on hunting in Uganda[48]. Local people may perceive a logical shift to be the utilization of problem animals both to allow the recovery of game species and to balance crop losses with bush meat gains (Naughton-Treves *et al.*, 2003).

[45] Weeds and crop disease are classed as internal issues as their manifestation originate within the field boundary. It is recognised that many weeds and diseases are spread by insects or environmental vectors i.e. wind, that do indeed cross into the farm.
[46] This is unlikely, as Nyabyeya Parish is experiencing extensive deforestation of its forest fragments. However, habitat pressure may force animals into further contact with people.
[47] It should be noted that many local people also want to kill lower ranking problem animals (i.e. bush duiker) however this is believed to be due to their status as game species and will be discussed further in the chapter.
[48] Previous research supports this assumption as evidence for hunting has been found in BFR (Plumptre *et al.*, 2003a)

Another reason for the perception of crop raiding as a particularly severe problem around BFR may be its association with other issues that can limit agricultural yield in addition to social and economic development.

6.4.1.2 Crop Damage as an Associated Issue

Crop damage by large vertebrates at this site is perceived to be intrinsically linked with many other factors. For example, loss of food can cause famine and lack of income can result in poor health, fewer educational opportunities and a delay in community level development. Interestingly, many key issues are believed to be increasing around BFR but crop damage is perceived to have remained the same. This is surprising as complaints about crop loss to wild vertebrates are increasing (Chapter 1). It suggests that although the problem of crop damage by wildlife has not changed, the rise in associated issues may have led to a decrease in tolerance.

Sickness is perceived to be a significant, and growing, issue around BFR and crop loss by wildlife is believed to contribute to this problem by limiting household income that could be used for medicine. Cases of HIV/AIDS have undoubtedly risen over the last twenty years[49] and at least two people died of the disease during this study (*pers obs*). "Coldness from the forest" is also believed to produce influenza[50] and malaria. Although this area is at very high risk from malaria (UMOH, 2006b), a decrease in temperature cannot cause either illness. However, it is possible that these conditions are associated with increased levels of precipitation from the forest. The swamp areas of BFR are known to harbour "vast populations of mosquitoes" (Paterson, 1991, p.181) and people are more likely to gather together during storms thus allowing the influenza virus to be transmitted more effectively (World Health Organisation 2003). Further research is needed to understand if forest communities are at a higher risk of

[49] The first case of AIDS was recorded in Uganda in 1982 (UMOH, 2006c). The current prevalence rate for this area (4.7%) is comparable with the national figure of 5% (Musinguzi *et al.*, 2003)

[50] Headache, fever, coughing and general body weakness define what local people describe as 'flu'. The symptoms are more like influenza than the common cold but it is not clear if this is indeed an infectious disease or some other form of illness. It is relatively common especially during the rainy seasons.

disease or whether the high perception of risk for this issue is due to isolation from medical facilities and limited access to technological developments e.g. bed nets.

Land availability is also seen as a problem that connects directly with crop raiding by wildlife. Previously low population density around Nyabyeya Parish (Hill, 2005) encouraged a traditional distribution of land; farms would be extended and subdivided through the generations (Taylor, 1969)[51]. However, due to their close proximity to the forest and inability to extend their agricultural area, families at this site state that they are now dependent on smaller parcels of land for cultivation. Mean farm size is particularly small (Chapter 4) and appears to have significantly reduced since the mid 1900s; in 1923 average farm size was estimated to be 1.4ha and in 1954 2.4ha (Roscoe 1923 & Beattie 1954 cited in Taylor, 1969). The increased reliance on small farms potentially results in a lower yield due to both limited land and reduced soil fertility (Hamilton, 1984). Furthermore, local people have fewer choices regarding the adoption of 'low risk' planting strategies (Naughton-Treves, 1996). This is likely to reduce tolerance for any crop damage by wildlife (Naughton-Treves and Treves, 2005, Priston, 2005). Local people are also concerned by land ownership; for example, Nyakafunjo is technically owned by NFA[52]. In addition, many farmers utilize land owned by Nyabyeya Forestry College through the Taungya agroforestry system. This method allows for the cultivation of annual crops on college land in exchange for the care of tree seedlings (Hill, 1997). However, local people are aware that this is not a permanent agreement and loss of this facility would have a significant impact upon livelihoods (*pers obs*). Temporary land use arrangements mean that farmers are, understandably, less tolerant of any damage.

### *6.4.2 Perceptions of the Forest*

The majority of local people around BFR have an economic relationship with the forest as opposed to any traditional, cultural or symbolic association (Lauridsen, 1999). As

[51] The reference relates to the indigenous Banyoro, however, participant observation suggests that many ethnic groups living in this area adopted a similar system of land distribution

[52] Local people describe how the Forest Department (now NFA) gave a small section of BFR to Budongo Saw Mills Ltd to be used for employees and their families (Lauridsen, 1999). This became established as the village of Nyakafunjo.

previously detailed (Chapter 4) the villages in this study are predominately populated with migrant labourers who were attracted to the area by the potential for economic gain. Indeed, all the male participants in the Nyakafunjo focus group were originally employed by the saw mill as lumberers or drivers and many now perceive no advantage from living close to the reserve. This is reflected in the emphasis on the utilitarian benefits of BFR and its wildlife; farmers in this study perceive the forest as primarily a source of basic human needs e.g. firewood, food, water and building materials. Poor families and those living closer to a forest are generally more reliant on forest products as a 'safety-net' (IIED, 1994)[53], however, the income derived from BFR is particularly low compared with other protected areas in Uganda (Bush *et al.*, 2004). This suggests that restrictions by the government and local authorities may prevent access to valued resources.

Many of the community argue that permits for timber extraction (and thus the primary economic benefit of the reserve) go to outsiders. This view, that external groups are the main beneficiaries of protected areas, has been reported at other sites (e.g. Parry and Campbell, 1992, Naughton-Treves, 1996, De Boer and Baquete, 1998, Gillingham and Lee, 1999, Gadd, 2005, Okello, 2005). Interestingly, many respondents in this study indicate that only recently has control of the forest moved from God and the local community to external organizations. This is surprising as the majority of the sample have only ever experienced BFR in the power of another entity such as the British Protectorate or the Saw Mill. It suggests that a personal stake in the forest, albeit through employment, is enough to make local people feel as if they 'own' or have responsibility for the reserve. With the absence of any perceived legal economic benefit, the forest is believed to be a source of problems. All associated factors that impact upon tolerance toward raiding wildlife are believed to be inextricably linked with BFR and crop damage appears to represent the 'worst' element of living close to a forest/ animal habitat.

[53] It should be noted that de Merode et al (2004) found that, whilst poorer families do rely on the forest during 'lean' periods, wealthier households gain a higher value of forest resources

*6.4.3 Perceptions of Specific Raiding Species*

In this study, chimpanzees are the only species to be considered in a predominately positive manner. However, it should be noted that a number of respondents fear these animals and are reluctant to adopt any crop protection strategies due to their potentially aggressive behaviour. This is a concern for any future conservation in this area as people are likely to become intolerant of a situation that they cannot control. It is particularly relevant for those growing sugar cane as the potential for economic loss already appears to be creating negative attitudes toward this endangered primate (Reynolds *et al.*, 2003, Paterson, 2005).

Kellert (1985) suggested that perspectives of animals in developing countries are often divided into material value or awe and respect. There is little evidence to suggest that chimpanzees fulfill any mystical or idealistic role around BFR as is found at other sites (e.g. Humle, 2003). Rather, the positive view appears due to anthropomorphic associations; many farmers discuss the phylogenetic link between chimpanzees and humans. However, perceptions of other raiding animals are based on strong utilitarian values; the majority of wildlife is only believed to be beneficial as a source of food, although it should be noted that chimpanzees were also seen in a utilitarian framework by a small number of interviewees who believe that the main benefit of this species is to advance medical science and aid the development of drugs to combat human disease.

Perceptions of other raiding species were more mixed. For example, views of baboons and bush pig are very negative amongst those living close to the forest edge. As this study has shown, these farmers are generally more vulnerable from incursions by wild species (Chapter 5). However, goats were not perceived to be a problem and yet a high number of farms are vulnerable to loss from these animals. Value judgments appear to be influenced by a complex combination of variables. It is important, therefore, to try and identify factors that have an impact upon beliefs and tolerance for raiding species.

6.4.3.1 The Impact of Body Size upon Perceptions

It has been suggested that body size is an important consideration when examining perceptions of crop raiding species (Naughton-Treves and Treves, 2005). This bias is seen in this study as large vertebrates are perceived to be more of a problem than insects despite their prevalence at this site (Chapter 5). Large animals tend to get a disproportional amount of blame for crop damage (e.g. De Boer and Baquete, 1998, Gillingham and Lee, 1999, Hill, 2004, Okello, 2005) especially in areas of low human density (Newmark *et al.*, 1994). This may be because they are visually intimidating, less likely to live in disturbed habitat[54] and able to cause considerable amounts of loss; for example, elephants can eat approximately 50kg of human foods per day (Sukumar, 1990). Large animals are also an obvious and detectable risk unlike 'invisible' threats to human health, for example, water contaminants (Fitchen *et al.*, 1987). Clarke (1953), suggests that large vertebrates also have the 'advantage' of being able to supply a substantial amount of meat in compensation for crop damage. Therefore there is an obvious benefit to complaining about these animals. However, body size does not adequately explain the differential perceptions of raiding species at this site. For example, chimpanzees are the largest primate in this study and yet they are perceived more positively than baboons. In addition, goats and bush duiker are a similar size and yet farmers' views of them are very different.

6.4.3.2 The Impact of Raiding Behaviour upon Perceptions

Raiding behaviour appears to have a significant influence on the perception of local people toward animals utilizing human food. For example, baboons are believed to embody "rebels" or insurgents. The use of military language to describe primates is not new and has been used in other conflict scenarios; macaques in Palau are perceived to be like an "invading foreign army" and in Japan people-monkey conflict is described as a 'war' (Knight, 1999, Wheatley *et al.*, 2002). However, one should note that many of the study sample have personal experience of rebel activity due to the ongoing political

[54] Hyenas appear to be an exception to this and have been found to attack livestock more frequently in areas with high human density. However, it is believed that their scavenging behaviour results in an association with humans and attacks on domestic animals are merely a reflection of opportunism (Kolowski and Holekamp, 2006)

instability in northern Uganda and neighbouring countries. In addition, during the early 1980's the area around BFR was the front line of military action between President Milton Obote's army and the NRM of Yoweri Museveni[55] (Nyangabyaki, 1991) Therefore, whilst equating baboons with Joseph Kony may seem flippant and distasteful given current socio-political conditions, it gives an indication as to why local people have intense dislike for baboons beyond actual crop damage.

Like rebels, baboons induce fear due to their unpredictable and seemingly planned forays into croplands (Hill, 2005). They are predominately terrestrial, often approach farms in large groups and are believed to have aggressive raiding strategies; farmers state that baboons are persistent and will not leave the farm even if they are seen (Hill, 1997, Warren, 2003). They are also perceived to be highly organized; key individuals often remain vigilant at the farm boundary and are thought to purposefully distract farmers in order to allow other individuals access to the farm (Bolwig, 1959, Poirier, 1971, Maples *et al.*, 1976, Knight, 1999, Hill, 2000, Warren, 2003)[56]. This use of "deceptive" strategies may lower tolerance for problem species as the animal is perceived to be willfully deceiving the farmer. Baboons are, therefore, believed to conduct a conscious and calculated assault on agricultural areas. However these negative perceptions are not indiscriminately applied to all primates.

Monkeys receive mixed responses by local people around BFR. The majority of farmers perceive them to be "thieves", a term used in other situations where monkeys and people are in close proximity (Shepard, 2002, Priston, 2005). However, many also think they are 'clever' and these associations highlight raiding behaviour that is more acceptable to local people. Unlike baboons, monkeys usually damage crops independently and make quick forays into agricultural areas. They are, therefore, perceived to be opportunistic as opposed to calculated and organized. Furthermore,

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[55] President Yoweri Museveni actually came to power in 1986. A bloodless military coup led by Tito Okello overthrew Milton Obote in 1985 and after negotiations with the NRM broke down, Museveni took control of the country.

[56] Maples *et al.*, 1976 recorded sentinel behaviour but stressed that it did not appear to be conscious rather it was associated with farm geography. However, it is included here as it may appear intentional from the farmer's perspective.

their predominately arboreal movement ensures that the farm boundary is not breached; rather the animal utilizes the semi-permeable nature of its structure. However, as the results indicate, this perception of monkeys is strongly influenced by proximity to the forest; as the intensity of forays into the farm increases, tolerance for monkey incursions is reduced. This suggests that the emphasis placed on these primates as "honest" is dependent on the perception that raids represent a fair contest between farmer and animal, in addition to maintaining the illusory divide between wild nature and agricultural domesticity. However, it is clear that raiding behavior is not the only influence upon perceptions of specific animals; feeding strategies are also highly influential.

6.4.3.3 The Impact of Feeding Behaviour upon Perceptions

Whilst baboon and bush pig have the potential to cause considerable damage (Chapter 5), farmers' perceptions do not appear based on actual loss but rather specific feeding behaviour.

Highly destructive and observable foraging strategies are viewed negatively by local people. For example, bush pigs are perceived as particularly damaging due to their rooting behavior (Kingdon, 1997) and at this site they are associated with mechanical machinery that can 'grade' soil. It is therefore surprising that bush pigs are perceived to cause less damage than they actually do (proportional to other species). This may be a reflection of the extremely negative perception of baboons rather than a positive evaluation of the bush pig. Baboons also undertake covert feeding behaviour; as pith eaters they chew the immature stems of a number of grass species in addition to *Zea mays* (Hill, 2000, Warren, 2003). This type of damage can be extensive and remove affected plants from production. Again, negative views toward this feeding strategy are not just due to loss but also perceived malevolence. By utilizing plant parts that are unsuitable for human consumption, baboons are believed to be 'wasteful' and destroy "even what they do not eat". (Bolwig, 1959, Naughton-Treves, 1997). This has been found in a number of studies for both primates and other terrestrial mammals (see Blair *et al.*, 1979, Naughton-Treves, 1996, Hill, 1997, Knight, 1999, Chalise, 2000/1, Wheatley *et al.*, 2002). It reflects the way in which social rules and human values are imposed upon wild animals.

Baboons are highly omnivorous and eat a wide range of foodstuffs from insects and seeds to gum and roots (Warren, 2003). Along with bush pig, they are perceived to eat the highest number of crop types in the area and be indiscriminate in their feeding habits. In reality, bush pig were only observed eating four agricultural crops and, whilst baboons consume a wide range of foodstuffs in this study, there is evidence that they are selective and will not eat everything available to them (Warren, 2003). However, their adaptability means that both animals are perceived as 'greedy' by local people. This has strong negative connotations as it is clearly not advantageous for any member of a rural community to be 'gluttonous', especially in a population that has previously been subject to food shortages and famine (Nyangabyaki, 1991). However, the anthropomorphic perception of feeding strategies is not always negative; chimpanzees and bush duiker are considered "respectful" and "disciplined" in the way they utilize human foods. Both species are believed to control the amount and part of the crop taken; only removing as many fruits or leaves as they require. This sense of self control has been found to impact upon positive perceptions of gorillas in Rwanda as it is believed to be a "quality intrinsic to what constitutes humanity" (Sicotte and Uwengeli, 2002, p.175).

The perception of wildlife species as a moral 'mirror' for human populations is found within many societies (Knight, 1999, Mullin, 1999). For example, the Matsigenka of Peru and Bari of Venezuala believe that they are ancestrally connected to primates and that their behaviour can be taken as a warning for undesirable human attributes; for example, the meat (i.e. head) of howler monkeys are taboo for some groups as it is believed to make people "slow" and "lazy" (Lizarralde, 2002, Shepard, 2002). By attributing human values to raiding species, local people indicate that they will tolerate animals that act within a human morality; any animal 'choosing' to work outside these values is perceived to be entering a personal feud with the farmers.

6.4.3.4 The Impact of Control upon Perceptions

One of the most pervasive factors that can influence perceptions of raiding species is control. For example, nocturnal animals are often tolerated less than diurnal species because farmers are unable to protect crops adequately against depredations (Hill, 1997, Hoare, 1999, Naughton-Treves, 2001, Hill, 2004). This is demonstrated in this study as bush pig and bush duiker are linked with the perceived prevalence of negative forces after sundown[57]. In addition, loss to domestic species is often tolerated despite significant damage to crops. Those experiencing goat raids are also the most positive about these animals suggesting that local people gain substantial benefit from their presence. They have an important cultural value for this community and a strong association with wealth and status; goats are traditionally used for dowry, food for important guests and family, and as sacrifices by witchdoctors (Taylor, 1969). Furthermore, they are a 'savings account', a contingency in case of emergency (Hill *et al.*, 2002, Hill, 2004). However, farmers also perceive that they can control damage from domestic species either by preventing the animals access to the field (i.e. tethering away from agriculture) or through the instigation of institutionalized methods of compensation (Naughton-Treves, 1996, Hill *et al.*, 2002, Warren, 2003, Hill, 2005). If a domestic animal is caught damaging fields around BFR, it is taken to the village council where the owner has to pay for its release or it is sold and the money used to recompense the aggrieved farmer (Hill, 2005)[58]. Goats become, therefore, a symbol of social cohesion as the behaviour of the animal is seen to reflect the owner. In contrast, the government is perceived to 'own' the forest and its animals and yet does not take responsibility for their actions; it is perceived to be a careless 'owner' (Naughton-Treves, 1996, Hill *et al.*, 2002, Gillingham and Lee, 2003). Farmers are neither able to control the situation or receive compensation for their losses. Consequently, tolerance towards wild species is reduced. This is further emphasized through examination of perceptions of traditional game animals, for example, bush duiker.

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[57] Bush pig are known to shift to diurnal activities if undisturbed (Vercammen *et al.*, 1993), however the high human population density at this site appears to restrict them to nocturnal movements.

[58] The 'arrest' of livestock was witnessed during this study.

Perceptions of bush duiker in this study are the most mixed of any raiding species; there is an almost equal distribution of positive and negative views. Many of the positive statements appear to reflect their status as a prey species as opposed to a crop raider; for example, "honest" and "brave" evoke the honour of the quarry (see Marvin, 2000). Other studies have suggested that game animals are tolerated better in conflict situations (Naughton-Treves and Treves, 2005) and this research suggests that this is due to perceived control. Whilst the farmer is unable to prevent crop damage, hunting raiding species (and thus gaining tangible benefits) enables local people to both manage the amount of loss and its subsequent impact upon livelihoods. Although the majority of local people in this study stated that eradication was their preferred method of crop protection for the bush duiker, many of these did not experience raids. It is therefore believed that this opinion is not a reflection on damage but their status as a game species in this area.

### 6.5 Summary

Crop damage by wildlife is believed to be the most significant risk to livelihoods around BFR. It can impact upon both economic and social development and local people feel unable to manage the risk as they are not permitted to use traditional methods of protection. In addition, the forest itself is believed to be under the control of the authorities and yet they are not seen to be taking responsibility for its negative impacts. Perceptions of raiding animals reflect different levels of tolerance and human values. Key factors that influence negative attitudes are if an animal is nocturnal, omnivorous, group foraging, terrestrial, perceived to be 'self aware', unpredictable, and persistent with covert raiding behaviour. Damage by domestic and game species can be managed, has associated benefits and thus is more readily accepted by farmers in this area.

In conclusion:

1. Although local people believe that they are exposed to many risks as a consequence of living next to BFR, crop loss to wild vertebrates is perceived to be the most significant problem

2. Crop raiding represents an external issue that is inextricably linked with the forest and other social factors

3. BFR is perceived in a utilitarian manner and potential benefits (i.e. meat and access to forest resources) are believed to be restricted by outside agencies

4. Attitudes toward raiding species are defined by anthropomorphic perceptions of raiding, feeding behaviour and control (see above). They also have an implied morality and reflect both positive and negative values within human society.

# 7. RESULTS: CROP PROTECTION STRATEGIES

## 7.1 Introduction

Recommended management strategies for crop raiding animals are diverse, often species specific (Hill, 1997) and rarely appropriate for primates or low income subsistence farmers due to a reliance on expensive technology or effective infrastructure. In addition, seldom have they been evaluated in any depth (Hill, 2000) and much of the data concerning traditional crop protection methods, and conservation practice generally, is anecdotal (Sutherland *et al.*, 2004, Osborn and Hill, 2005). Conservationists have often argued that the only way to solve crop raiding is to reduce the competition for resources between animals and humans, for example, by keeping agricultural crops away from the forest edge, conserving large tracts of forest, moving farmers out of conflict zones or translocating problem species (e.g. Newmark *et al.*, 1994, Strum, 1994, Naughton-Treves, 1997, Saj *et al.*, 2001, Imam *et al.*, 2002, Sitati *et al.*, 2003, Okello, 2005). There is no doubt that these measures would reduce and potentially eradicate crop raiding in the long term, however they are impractical, expensive and without careful implementation could just move the problem elsewhere (Osborn and Hill, 2005).

Traditionally, farmers used lethal techniques to keep animals out of farms (Taylor, 1969, Mascarenhas, 1971, Vansina, 1990, Hill, 2000, Andama and McNeilage, 2003). However, conservation legislation means these methods are restricted in many areas of human-wildlife conflict (e.g. Naughton-Treves, 1996, Andama and McNeilage, 2003, Jackson and Wangchuk, 2004, Naughton-Treves and Treves, 2005). Despite this, the hunting of crop raiding species, particularly primates, is still seen (Fitzgibbon *et al.*, 1995); for example, in Gambia, organized village hunts kill up to 300 monkeys at one time (Starin, 1989, Barnett and Emms, 2002)[59]. Not all lethal control is illegal, some governments do still undertake culls of problem species; the USA disposed of over 75,000 coyotes in 2004 (USDA Wildlife Service 2004) and 6666 monkeys were killed

[59] Whilst hunting is illegal in the Gambia, the Wildlife Conservation Act (1977) states that local people can take 'reasonably necessary measures' to protect crops or property from wildlife (Starin, 1989). However, communal monkey hunts by up to 11 villages seem a disproportionate level of force and may serve to demonstrate the heightened tensions that exist in this area.

per year in Japan during the 1990s (Environment Agency 2000 cited in Sprague, 2002). In addition, hunting quotas are often modified to include problem animals (Conover and Decker, 1991). However, lethal control is not believed to be effective in the long term as it is expensive, animals can disperse to other localities, other groups can replace the removed individuals and species populations can go into decline (Mascarenhas, 1971, Brennan *et al.*, 1985, Horrocks and Baulu, 1988, Else, 1991, Biquand *et al.*, 1994, Strum, 1994, Osborn and Hill, 2005, Paterson, 2005). Furthermore, primates have been recorded returning to fields where members of their troop were killed (Forthman-Quick, 1986, Andama and McNeilage, 2003, Priston, 2005). Sterilization and contraception have also been used to slow the reproductive rate of raiding primates and ungulates but it is costly and highly invasive (Biquand *et al.*, 1994, Craven and Hygnstrom, 1994).

Exclusion strategies, e.g. trenches, walls, fences and buffer zones of non-palatable but highly profitable crops, are often used to prevent animals reaching agricultural areas (e.g. Mascarenhas, 1971, Bell, 1984, Brooks *et al.*, 1989, Jhala, 1993, Strum, 1994, Naughton-Treves, 1998, Poole *et al.*, 2002, Andama and McNeilage, 2003, Geisser and Reyer, 2004). Tree trunks or fruits can also be wrapped in unpalatable leaves, plastic or cloth to prevent loss (Yayock *et al.*, 1988, Hunter, 1996, Priston, 2005) and coconut shell muzzles have been used to stop domestic animals from grazing on valued foodstuffs (A. Banerjee in Chambers, 2002). Although barriers show some potential with ungulates, porcupines and rabbits (Craven and Hygnstrom, 1994, Biryahwaho, 2002, Andama and McNeilage, 2003, DEFRA, 2004), primates easily negotiate obstructions and bush pig and elephants can damage or destroy fences (e.g. Maples *et al.*, 1976, Bell, 1984, Barrett and Birmingham, 1994, Strum, 1994, Hone, 1995, Priston, 2005, Sitati *et al.*, 2005). Sisal (*Agave sisalana*) and Mauritius thorn (*Caesalpinia decapetala*) may reduce crop raids by wild vertebrates including baboons (Mascarenhas, 1971, Andama and McNeilage, 2003) but introducing plant species can be problematic; i.e. Mauritius thorn is highly invasive and requires significant management to avoid incursion into cultivated areas (Andama 2006, *pers comm*, IUCN, 2006). In addition, high technology solutions such as electric fences and trenches can be expensive to install and maintain and thus not appropriate for the majority of subsistence farmers (Mascarenhas, 1971, Blair *et al.*, 1979, Bell, 1984, Hill, 1997, Osborn and Hill, 2005). The use of barriers has also been criticized by some conservationists as they can create ecological isolation by restricting traditional migration patterns (Jhala, 1993, Newmark *et al.*, 1994, Naughton-Treves, 1996, Sekhar, 1998).

Guarding is commonly seen in agricultural communities; treetop look-outs, firecrackers, stone throwing, shouting and chasing with dogs are all used in defense of agricultural crops (e.g. King and Lee, 1987, Biquand *et al.*, 1994, Naughton-Treves, 1996, Hill, 1997, Chalise, 2000/1, Saj *et al.*, 2001, Rao *et al.*, 2002, Sprague, 2002, Madhusudan, 2003, Warren, 2003). Reports as to the efficacy of guarding are mixed. Primates, like wild pigs, are highly adaptable, unpredictable and will modify their behaviour to avoid threats (Maples *et al.*, 1976, Barrett and Birmingham, 1994, Strum, 1994, Hill, 1997, Naughton-Treves, 1998, Hill, 2000). However, it has been suggested that guarded fields are avoided by primates (Naughton-Treves, 2001, Wheatley *et al.*, 2002, Priston, 2005) and experience fewer livestock depredations by carnivores (Madhusudan, 2003).

Repellants and deterrents have also shown some potential at protecting crops from primates and other raiding species; chilli has been used against monkeys and elephants (Strum, 1994, Chalise, 2000/1, Osborn, 2002, Warren, 2003) and soap or goat dung against duiker and deer (Craven and Hygnstrom, 1994, Hill, 1997). However, there is a risk that with repeated exposure, repellents and deterrents will lose their efficacy as animals habituate; mountain gorillas no longer respond to bells in Uganda (Madden, 1999) and noise scaring was not effective with baboons in Saudi Arabia (Biquand *et al.*, 1994). Scare devices that are triggered by motion or an individual wearing a radio collar, do show some potential but are expensive to implement and highly invasive (Biquand *et al.*, 1994, Craven and Hygnstrom, 1994). Although effective with some deer (Craven and Hygnstrom, 1994), taste aversion has shown similar limitations; bears were not deterred from conflict areas (Peine, 2001) and primates can detect the emetic which means each individual has to be injected for each novel foodstuff (Forthman-

Quick, 1986). It indicates that, like guarding, no deterrent will be totally effective for all species however they do show some potential if used with other methods (Forthman-Quick, 1986, Madden, 1999).

There are clearly many different techniques to remove, deter and repel raiding wildlife from agricultural areas. This chapter will examine observational and attitudinal data to understand the actual and perceived efficacy of crop protection methods in villages around BFR.

Thus the specific aims are:

- To ascertain which crop protection strategies are being used by farmers at the study site

- To examine local people's perceptions of these strategies

### 7.2 Methods

The presence of lethal and non-lethal crop protection methods (e.g. snares, leg-hold traps and scarecrows) were recorded during weekly monitoring of farms and their location stored in a GPS. Dogs and animal skins were classified as non-lethal strategies[60]. Bows, arrows and spears were seen in compounds but not recorded as lethal methods unless they were observed being used to kill an animal. Pangas (machetes) are used for many household tasks so it was also not appropriate to classify them as lethal strategies unless they were seen being used for this purpose. Records of crop protection techniques are likely to be conservative as many methods are illegal.

'Guarding' is an extremely difficult strategy to analyse (Naughton-Treves, 1996) as it incorporates many different techniques. For example, it is most commonly defined as both (i) the presence of the farmer in the field due to the 'potential' for crop raids (this can include active monitoring and reconnaissance but often involves the practice of supplementary activities whilst remaining vigilant) and (ii) the action of chasing an animal from the field once detected often by shouting and banging objects. In many ways it is a misleading term as 'guarding' in this context does not necessarily include the active removal of wildlife from farms or patrolling agricultural areas. However, animals may be deterred from entering a farm whilst people are present and farmers have the potential to protect their crops by chasing observed wildlife out of the field. In order to thoroughly evaluate the efficacy of guarding, farms known to experience crop loss to wildlife would need to be monitored whilst guarding intensity and techniques were manipulated[61]. This was beyond the remit of this study; however it was possible to examine the impact of an elevated level of human presence upon crop raiding around BFR. Farmer presence was recorded across the three seasons; if local

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[60] The main role of dogs in this context is to repel and deter crop raiders. It is recognized, however, that they can cause fatal injury to raiding species and were, on one occasion, seen killing a red-tailed monkey. Skins of raiding primate species are frequently used in crop protection to deter potential raiders from entering agricultural areas (e.g. Starin, 1989, Strum, 1994, Saj *et al.*, 2001). In this example, a baboon had been killed and its skin hung at the forest edge to discourage the rest of the group from entering the field. Although it is a lethal strategy for the baboon concerned, it is listed here as a non-lethal crop protection method as it is being used as a repellant.

[61] This still does not satisfactorily deal with the problem of measuring 'vigilance'; a farmer shelling beans or planting seeds can also be listening and watching for signs of wildlife in the field.

people were observed in farms for a mean of more than 50% of weekly visits this was defined as guarding. While there are obvious limitations to this method (we often visited on the same day of the week and farmers may be in the farm for short time intervals) it was felt that this analysis would give a rudimentary measure of human presence over the three field seasons and reduce the possibility of chance encounters. Despite its ambiguity, the term 'guarding' is used to describe this level of human presence as that is how local people define the activity. It was felt appropriate to use their definition as perceptions and actual use of protection strategies will be compared in this chapter. Guard huts were not included as a measure of guarding as they are not an accurate indicator of vigilance or human presence; these structures were frequently empty.

Perceptions of crop protection strategies were ascertained in semi structured interviews (SSIs), focus group discussion and participant observation. See Chapter 6 for an in-depth description of these methods. Sample size is frequently too small for accurate statistical analysis (chi-square), therefore basic interpretation of frequencies and percentages are made unless otherwise stated.

## 7.3 Results

### *7.3.1 Crop Protection Strategies in Use (Observed in Farm Monitoring)*

Guarding is the most commonly observed crop protection strategy around BFR (Figure 7.1); 63.5% of farmers (N=129) remain on their fields to try and keep large vertebrates away from crops. Dogs are also encountered (n=13) and one farmer has a trained pack to assist him whilst hunting in the forest. Scarecrows are also periodically observed; 11.6% of farms use rags, plastic bags, jerry cans and even the tape from inside an audio cassette to scare large and small vertebrates from crops (Figure 7.2a and b). One farmer uses a scarecrow dressed in human clothes and positions it undertaking human activities e.g. drinking tea and hoeing. Fences of living plants, wood or wire (Figure 7.2c and d) are also seen at this site.

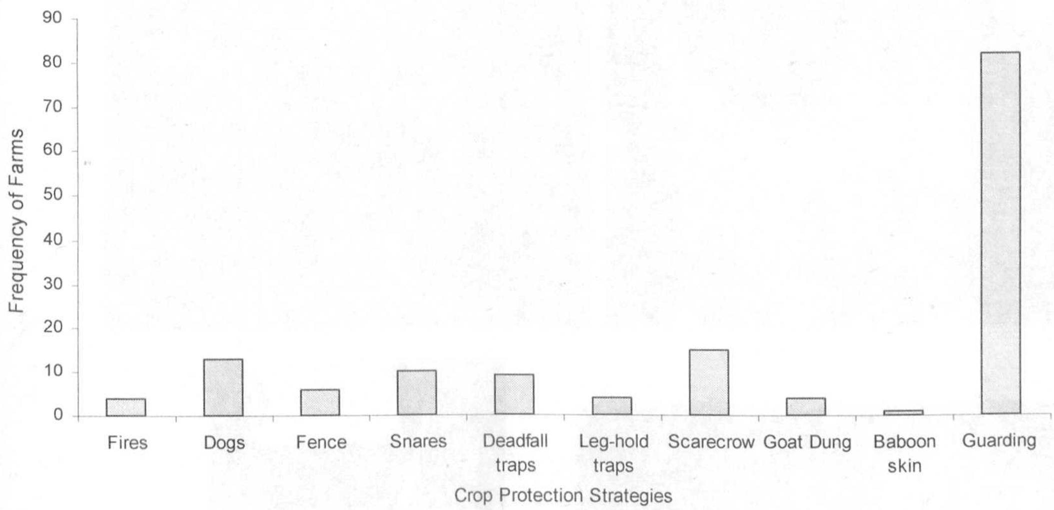


**Figure 7.1 Crop protection strategies in use around Budongo Forest Reserve (N=129)**

Lethal methods are also used; 17.8% of farmers use snares, leg-hold traps and/ or deadfall traps. Snares are the most prevalent lethal strategy and are found in 7.7% of farms (Plate 7.2e). They are primarily intended to capture baboon, bush pig and bush duiker although one was seen up a tree because a farmer was experimenting to see if he could catch monkeys. Leg-hold traps are used in 4 farms and baboons and bush pig are the target species. Deadfall traps (Plate 7.2f), in contrast, are primarily for small vertebrates e.g. squirrels and rats.

**Plate 7.2 Photographs depicting crop protection strategies observed around Budongo Forest Reserve; a) scarecrow 1, b) scarecrow 2, c) living fence of *Manihot sp*, d) wire/ wood fence, e) snare, f) deadfall trap**

Bows/arrows and spears are occasionally seen in compounds but were never observed being used to kill animals. No evidence of poisoning was seen but it is known to be used in this area[62]. There is no statistical difference in the distribution of crop protection strategies at the village level.

The use of lethal/ non-lethal strategies and guarding is subject to seasonal variation; fewer farmers employ methods to reduce crop loss in the second agricultural season (Study Season 3 - August until end of October). Indeed, no farmer was observed using lethal strategies on their farm during this period:

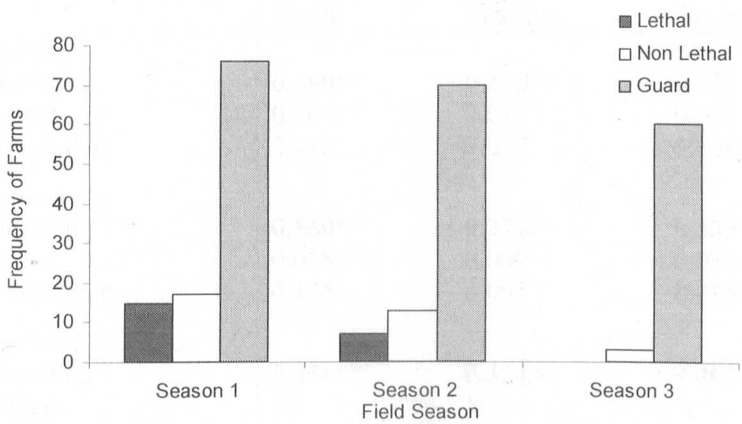


**Figure 7.3 Farms using crop protection strategies by season (N=129)**

The decrease in crop protection strategies between study season 1 and 3 may be linked to the reduction in crops planted at this time (Chapter 4). A significant association is found between the presence of guarding and the presence of food crops in Season 2 and 3 (Season 2 Cramer's V=0.295, N=129, $p<0.01$; Season 3 Cramer's V=0.346, N=129, $p<0.01$). Proportionally, guarding is more common in fields that have food crops. There is no association between the cultivation of food crops and use of lethal or non-lethal strategies.

[62] Farmers discussed injecting fruit with pesticide to kill monkeys. The type was not clarified although Paterson (2005) reported that fluradan was being used for this purpose by local people around BFR. Poisoned bait has also been used against birds in this area (Hill, 1997).

There is a significant statistical association between crop protection strategies and the cultivation of specific food crops (Table 7.1). Guarding is usually found in farms that are growing maize and/or cassava. There is an inverse relationship with sweet potato cultivation; proportionally, guarding is found more often in fields without the crop. Lethal and non-lethal strategies do not have any statistical association with the growth of maize or cassava. However, sweet potato was found to have a negative relationship with non-lethal strategies in Season 2.

**Table 7.1 Measures of association between the presence of crop protection strategies and specific food crops per season (Cramer's V, N=129, bold figures are significant at *p<0.05, **p<0.01)**

| | Maize | Cassava | Sweet Potato |
|---|---|---|---|
| *Season 1* | | | |
| Guarding | **0.380**** | **0.378**** | 0.127 |
| Lethal | 0.107 | 0.012 | 0.087 |
| Non-lethal | 0.118 | 0.027 | 0.128 |
| *Season 2* | | | |
| Guarding | **0.560**** | **0.277**** | **0.333**** |
| Lethal | 0.008 | 0.009 | 0.083 |
| Non-lethal | 0.135 | 0.095 | **0.196*** |
| *Season 3* | | | |
| Guarding | **0.456**** | **0.334**** | **0.461**** |
| Lethal | X | X | X |
| Non-lethal | 0.101 | 0.098 | 0.123 |

There is a significant difference between farms that experience crop damage and the presence of guarding for each season; these data are separated into seasons to lessen any temporal affect upon the use of strategies (Season 1 $\chi^2$=9.428, df=1, p<0.01; Season 2 $\chi^2$=13.844, df=1, p<0.01; Season 3 $\chi^2$=12.489, df=1, p<0.01). Raids are observed more frequently in fields with guarding than without. This distribution is also seen for non-lethal strategies but not for all seasons (Season 1 $\chi^2$=9.790, df=1, p<0.01; Season 2 $\chi^2$=7.173, df=1, p<0.01). There is no significant difference between the presence of lethal strategies and whether crop raids were experienced. It is not possible to analyse area lost due to small sample size (chi-square). However, when crop protection strategies are entered into logistic regression and the dependent variable split into incursions by wild and domestic species (Chapter 5, p85-87), guarding has an association with damage events by wild animals. In season 1 and 2, guarding significantly reduces the chance of wild raids being present (Exp(B)=0.593 and Exp(B)=0.334 respectively). Lethal and non-lethal strategies do not have any significant impact upon the model.

### *7.3.2 Crop Protection Strategies in Use (Stated in Interviews)*

During SSIs farmers were asked to list the methods they use to protect their fields from large vertebrate damage and these were compared with observations during the study period.

**Table 7.2 Percentage of farms observed using specific crop protection methods (N=129), compared with stated use in interviews (N=93)*. Bold figures indicate the highest rank for that category.**

| *Strategy* | *Observed Use* | *Stated Use* | *Primary Target Species*** |
|---|---|---|---|
| ***Lethal*** | | | |
| Bow & Arrow/ Spear | - | **8.6%** | All large vertebrates |
| Snares | **7.7%** | 3.2% | Baboon, Bush Pig, Bush Duiker |
| Deadfall traps | 6.9% | - | All small vertebrates |
| Leg-hold traps | 3.1% | 2.1% | Baboon, Bush Pig |
| V-shaped trench | 0% | - | Bush Pig, Bush Duiker, Buffalo |
| ***Non-Lethal*** | | | |
| Guarding – vigilance/ chasing/ shouting | **63.5%** | **81.7%** | All large vertebrates |
| Scarecrow | 11.6% | 1% | All large and small vertebrates |
| Fires | 3.1% | 16.1% | Bush Pig |
| Dogs | 10% | 9.6% | All large vertebrates |
| Fence | 4.6% | 13.9% | Bush Pig, Porcupine |
| Bells | 0% | 3.2% | All large vertebrates |
| Paraffin/Soap | 0% | 1% | Bush Duiker, Bush Pig |
| Goat Dung | 3.1% | - | Goat, Bush Duiker |
| Baboon Skin | 0.7% | - | Baboon |

* Totals are more than 93 and 129 as many farmers used or listed multiple methods
** Only primary target species are listed although it is recognized that some techniques can be adapted for use with other species

Guarding is the most commonly reported and used strategy; 81% of farmers (N=93) state they guard crops to protect them from animals. Scarecrows are used by fifteen farmers within the study sample and yet only one person listed them as a strategy that they use to protect crops from raiding animals. In contrast, fires and fences are rarely seen in farms and yet are stated to be in use by 16.1% and 13.9% of the study sample.

Interestingly, nearly 80% of those with lethal strategies on their farm did not state that they used these methods for crop protection. Statistical significance could not be tested due to the small sample size (chi-square), however there are no differences in distribution between observed and stated guarding, lethal and non-lethal strategies.

### *7.3.3 Solution to Crop Raiding and Perceived Efficacy of Protection Strategies*

Nineteen percent of respondents (N=83) state that they do not know how the problem of crop raiding can be solved (Table 7.3). Thirty seven percent of interviewees believe that the situation is irresolvable and 7.2% believe the farmer must "learn to cope", "be patient" and learn to "share with the animals". Almost one fifth of respondents believe that the situation is irresolvable because of a compounding situation (i.e. animals are still producing offspring and hunting or removal of forest cover is prohibited).

**Table 7.3 Local people's perceptions of the solution to crop damage by wildlife (N=83)**

| *Response* | *Frequency* | *Percentage* |
|---|---|---|
| *Don't Know* | *16* | *19.3* |
| *Passive* | *31* | *37.3* |
| Irresolvable | 8 | 9.6 |
| Irresolvable unless change in conditions | 17 | 20.5 |
| Irresolvable, must be patient | 6 | 7.2 |
| *Proactive* | *27* | *32.5* |
| Shooting/ Killing/ Poison/ Trapping | 18 | 21.7 |
| Guard/ Chase | 7 | 8.4 |
| Move Away from Area | 2 | 2.4 |
| *Donor Led* | *5* | *6* |
| *Other* | *4* | *4.9* |
| **Total (Missing)** | 83 (10) | 100 |

However, 32.5% of respondents believe that proactive measures are the only answer to the issue of crop raiding animals. Suggestions include killing, trapping and chasing raiding species or moving the household to another area. Only 8.4% believe that guarding is the solution to crop raiding. Six percent believe donors should assist by 'educating' or bringing a fence.

There are some interesting distributions of the perceived solution to crop raids; 39.7% (N=73) of farmers that experience raids believe the problem of crop raiding is irresolvable. In contrast, half of those who are not raided believe that pro-active methods are the only way to keep large vertebrates from damaging crops. Gender also appears to have an impact on perceived solutions to raids; 42.4% of women (N=33) state that the problem cannot be solved but 36% of men (N=50) regard pro-active methods to have potential to solve crop raiding.

When analysed by village, a donor led solution to crop damage by wildlife is only expressed by local people in Nyabyeya II and Nyakafunjo. Interestingly, only the poorest members of the study did not believe that the answer lay in requesting assistance from external organisations. Ethnicity also appears to have an impact upon perceptions. Over half (52.6%, N=19) of the Congolese and 60% (N=5) of the Banyoro regard pro-active measures to be the solution to crop raiding. In contrast, over a third of those from the West Nile (35.7%) state that they do not know how to solve the problem. Distance from animal habitat also appears to have an impact upon views as the majority of farmers adjoining or within 250m of forest or plantation (and therefore at highest risk from crop damage by wildlife – Chapter 5) believe crop raiding is irresolvable; 40.7% (N=27) and 37.5% (N=40) respectively. For those over 250m away, the highest response is that greater use of pro-active techniques is the solution (37.5%, N=16).

During focus group discussion and participant observation, local people were asked if they knew of effective techniques to prevent crop loss and reasons why they are/are not being used. Although some strategies are deemed as being very effective in preventing crop raiding (e.g. fences, fires, nets for game drives), local people state that they would require financial assistance to utilize these methods. Goat dung sprayed on crops is also believed to be an effective technique but is rarely used as farmers either did not own a goat or the dung was considered difficult to collect. One group discussed the use of digging a v-shaped hole to trap bush pig. Again, while it is viewed as effective, it is not being used because UWA does not authorize the trapping of animals. This is also found with hunting which is considered an effective crop protection strategy that is restricted by conservation legislation. Focus groups state that hunting traditionally takes place throughout the year in the forest but with a peak of activity from January to March around agricultural areas. This is when the bush is burnt in preparation for planting or is still relatively short. Some farmers also hunt in December as it is thought that during the dry season animals are more accessible because they must come close to the edge of the forest in search of food

*7.3.4 Requirements to Accept Novel Strategies*

During SSIs, farmers were also asked to identify what they would require to try a new crop protection strategy suggested by either an external agency or community member. Where more than one answer was given, the first response was recorded.

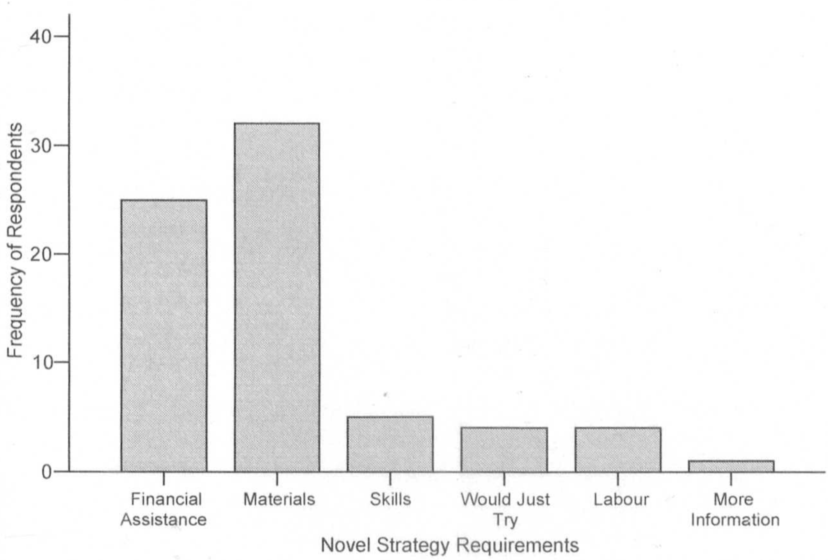


**Figure 7.4 Local people's requirements if they are to accept novel crop protection strategies (N=71)**

A high number of respondents (45%) state that they require materials and/ or financial assistance (35%) in order to be willing to try a new conflict mitigation strategy (N=71).

Skills and labour are only needed by 5 and 4 interviewees respectively and only 5.6% say they would try a new system without some form of assistance.

A higher proportion of those who experienced crop damage want financial assistance and materials (36.6% and 46.6%, N=60) than those who did not (27.2% and 36.3%, N=11 respectively). Although many of those over 46 request the same assistance (87.5%, N=24), they are the only age group to express willingness to try novel techniques without aid. In contrast, no farmers in Nyakafunjo expressed willingness to try a novel strategy without some type of assistance. There is no relationship with distance from animal habitat although those who farm within 250m of the forest predominately request financial assistance and materials to try novel crop protection techniques. Those farmers cultivating more than 250m from forest, degraded forest or plantation are more varied in their response.

## 7.4 Discussion

### *7.4.1 Crop Protection Strategies in Use*

Local people are employing a variety of lethal and non-lethal crop protection methods to deter, repel and kill wild animals raiding their fields. The majority of techniques are designed to protect crops from bush pig, bush duiker and baboon. This is unsurprising as they are the most destructive wild species at the study site (Chapter 5). In contrast, few strategies are aimed at domestic animals (e.g. goat) despite significant damage and subsequent impact upon crop yield (Chapter 5). However, domestic species are not perceived to be a major problem at this site (Chapter 6).

As recorded in other studies (Hill, 1997, Paterson, 2005, Tweheyo *et al.*, 2005), the most frequently used crop protection strategies around the southern edge of BFR are guarding and scarecrows. Both are non-lethal, require little economic or technological input and are therefore accessible to all members of the community regardless of age, gender and social status. Guarding and scarecrows are also flexible, non-specific and can deal with varying intensities of risk. These factors are likely to explain their widespread application in this area; farmers are poor and are trying to defend highly vulnerable crops (e.g. maize and cassava) from a variety of animal species. However, guarding does appear to have an impact upon crop damage by wild species and there were fewer raids in farms with a consistent human presence. This has been found in other studies; an increase in guarding intensity in Kenya reduced the frequency of elephant raids by almost 90% (Sitati *et al.*, 2005). In addition, raids by baboons and macaques reduced in frequency and duration with elevated levels of guarding (Maples *et al.*, 1976, Priston, 2005). However, Priston's study (2005) also revealed that this was affected by previous raiding experience; if macaques were chased out of the farm early in their raid bout, they would spend more time on the field boundary waiting for another opportunity to access crops. As feeding on human foodstuffs is so much more efficient for raiding species (Chapter 2), guarding is only effective if the animal is persistently harassed (Strum, 1994). Indeed, it has been reported that baboons prefer low-risk, food poor habitat as opposed to one that may offer valuable food but with an increased vulnerability to predation (Cowlishaw, 1997). This may explain the anomalous result that, generally, guarding is associated with raids. It suggests that local people guard as a reaction to crop damage and those that have experienced raids, and are therefore at higher risk, tend to be those that guard most often. This has been found at other sites in Uganda (Naughton-Treves, 1996).

Other non-lethal techniques (e.g. fires and fences) were encountered sporadically around BFR. Dogs were observed on 10% of farms although it is difficult to ascertain if all animals were used for crop protection. Results on the efficacy of dogs in human-wildlife conflict situations are mixed. Some studies state that they are ineffective against carnivores (Kolowski and Holekamp, 2006). Others stress that using dogs as part of a package of non-lethal techniques has reduced livestock depredation (Brenner, 2005), repelled bears from human settlements (Peine, 2001) and effectively warned against pig incursions (Brooks *et al.*, 1989). There is no relationship between non-lethal techniques (excluding guarding) and the presence of crop damage by wildlife. However, this may be a reflection of the small sample within this study.

Snares and traps were recorded in almost one fifth of farms but few reported their use. It could be due to their illegality (as found in Johnson, 1996, Naughton-Treves, 1996, Ezealor and Giles, 1997, Warren, 2003, Tumusiime, 2004, Paterson, 2005) or knowledge of the research study; deadfall traps are designed for small animals such as rats and squirrels and farmers knew that this research primarily concerned crop damage by large vertebrates. However, local people were happy to discuss the use of bows/ arrows/ spears in crop protection although their usage was never observed in practice. For these reasons, it is difficult to examine their full impact upon crop raiding. Other studies have suggested that those living near hunters are likely to experience lower levels of damage (Naughton-Treves, 1996, Hill, 1997). Unlike guarding and non-lethal techniques, farms with lethal strategies in this sample are not always those with crop damage or even food crops. The results indicate that lethal strategies may not be used solely to protect human foods from depredation; some farmers around BFR use snares and leg-hold traps to obtain wild animal meat.

### *7.4.2 Solutions to Crop Raiding and Perceived Efficacy of Protection Strategies*

The most commonly utilized crop protection strategies around BFR are not always believed to be the most effective (see also Else, 1991, Newmark *et al.*, 1994, Ezealor and Giles, 1997). Farmers at the study site equate efficacy with the permanent separation of people and wildlife. However, these methods are often not available to them because of economic or legal restrictions.

#### 7.4.2.1 Perceptions of Non Effective Strategies

Guarding is not regarded as a valuable crop protection method by local people. This is despite its prevalence and the fact that it is accepted as an effective strategy against monkeys (Chapter 6). Indeed, less than 10% of farmers in this study believe that it is a solution to crop raiding and previous research has indicated that farmers do not consider guarding an effective strategy when used without other methods (Hill, 2000). This result was also found with scarecrows which are widely used and yet not considered a successful way of keeping animals away from valued foodstuffs; no-one included them in their list of potential solutions to crop raiding. Although it is unsurprising that local people are utilizing the most accessible crop protection strategies, it is important that we begin to understand why farmers perceive these methods as ineffective. This will assist in the design of future conflict mitigation interventions.

Despite requiring little financial or technological input, guarding has a number of social costs. As it is a 'reactive' method of crop protection (van Vuren and Smallwood 1996), farmers must be present throughout periods of crop vulnerability (Hill, 2000). With diurnal and nocturnal raiders in this area, fields must be protected both day and night. Guarding is, therefore, labour intensive and requires the cooperation of all members of the family or a paid workforce (Mascarenhas, 1971, Bell, 1984, Hill, 1997, Naughton-Treves, 1998, Andama and McNeilage, 2003, Gillingham and Lee, 2003). This is even more significant if the farmer has multiple fields (Hill, 2000). Those with limited labour, therefore, (i.e. people living alone or female headed households) are especially vulnerable to labour bottlenecks and increased financial outlay (Hill, 1997, Osborn and

Hill, 2005). The education of children can also suffer as a consequence of guarding crops (Bell, 1984, Naughton-Treves, 1997, Fall and Jackson, 2002, Lee and Priston, 2005). Although primary education is free in Uganda, 19.3% of ten year olds and 22.2% of twelve year olds do not attend school in order to work (Rogers, 2005) and children are often observed in fields at the study site. Other social costs include the risk of injury/ death when guarding against large or dangerous species (Bell, 1984, Naughton-Treves, 1998, Madden, 1999, Hill, 2000, Fall and Jackson, 2002) and exposure to disease such as malaria if guarding at dusk or night (Naughton-Treves, 1996, Hill, 2005). It is likely that these high social costs contribute to farmers' perceptions of guarding as an unsuccessful strategy. However, why scarecrows are regarded as ineffective is not clear.

Scarecrows were seen on 15 farms at the study site yet only one person stated that they use them. Around BFR, scarecrows usually consist of isolated items of household rubbish and are seldom used in a systematic manner. This may be due to wealth factors as many farmers in this area of Uganda cannot afford to build and maintain elaborate scare devices. However, it may be because local people do not really consider scarecrows an effective crop protection strategy but use them because they have few alternatives (Fall and Jackson, 2002). Clearly, further research is needed to assess the efficacy of scarecrows; animals, especially primates, can quickly become habituated to this form of deterrent (Maples *et al.*, 1976, Cousins, 1978).

Examination of the strategies that local people *do* value as effective reveals that the separation of wildlife from agriculture may be as important as social factors.

7.4.2.2 Perceptions of Effective Strategies

Fences and fires are non-lethal strategies that also require labour from farming communities. However, unlike guarding and scarecrows, these barrier methods are perceived as highly valued strategies both here and at other sites (e.g. Nepal and Weber, 1995, Sekhar, 1998, Rao *et al.*, 2002, Okello, 2005). This is potentially due to a reduction in labour and associated social costs; farmers may not need to continue guarding once construction is completed. The possibility that perceived efficacy is equated with the specific raiding species rather than the method in place should also not be disregarded. Baboon and bush pig are considered the biggest problem around BFR and the majority of 'effective' techniques are aimed at these species (lethal strategies and barriers). In addition, barrier methods are not perceived to be effective in Nigeria, but only 23.8% of farmers regard the target species (warthog) as a problem animal (Warren, 2003). However, the value of fences and fires along with traps and snares could also be due to their perceived ability to permanently exclude animals from fields.

The construction of barriers enables local people to physically separate wildlife from agricultural areas. Interestingly farmers at this site only perceive this to be positive; in other locations there has been concern that the erection of fences or walls will limit access to resources (De Boer and Baquete, 1998, Biryahwaho, 2002). Unlike barriers, guarding and scarecrows are 'point-specific' and animals are only prevented from entering where the human or scarecrow is located; as one farmer described "if you chase them [baboons] at one end of the farm, they will come around the other". One could argue that isolated fires are also specific in location; however, local people state that they would like to use a fire on each field corner. The smoke/ sound created by the flames could be perceived to form an impenetrable defense. Scarecrows could also be perceived as a barrier method if they are used at regular intervals along a boundary as seen in Indonesia (Priston, 2005). However, their spatial isolation at this site prevents such a definition. Lethal strategies also permanently separate wild animals from agricultural areas.

Although there is some evidence that trapping within the forest is no longer economically viable due, in part, to BFP's snare removal programme (Tumusiime, 2004), over one fifth of respondents believe that a lethal strategy is the solution to crop raiding vertebrates. This preference for lethal techniques amongst those experiencing loss has also been found in other studies (e.g. Alghali and Bockarie, 1994, Oli *et al.*, 1994, Loker *et al.*, 1999, Zinn and Andelt, 1999, Fall and Jackson, 2002, Wheatley *et al.*, 2002, Gillingham and Lee, 2003, Warren, 2003, Marchal, 2006). Very likely this is due to the historical and cultural role of vermin control in rural communities; farmers traditionally hunted crop raiding species prior to periods of intensive agriculture (Vansina, 1990). These activities are culturally institutionalized in many societies (Knight, 2000a, Hill, 2005) and historically, government wildlife management programmes were also preoccupied with trying to keep animals within protected areas and eradicating problem species (Brooks and Buss, 1962, Mascarenhas, 1971, Bell, 1984, Fall and Jackson, 2002). However, whilst there is evidence that hunting has had an enduring role in local culture, the exclusion of specific raiding animals appears to be more important to perceived efficacy than an actual reduction in crop damage. The results appear to indicate that local people regard a successful crop protection strategy as one that separates problem animals from people as opposed to more effective ways of tolerating their presence (also described in Hill, 1991). In this sense, raiding animals are perceived as 'unnatural' and need to be completely removed from the agricultural area (Knight, 2000a); farmers in Kenya wish to use pesticides to 'clean' their field of pests or dirt (Williamson *et al.*, 2003). However, if these techniques are regarded as highly efficient why are they not seen more regularly at this study site? The results indicate that their limited use is primarily due to economic limitations and conservation legislation.

### *7.4.3 Limitations in the Use of Effective Strategies and Crop Raiding as Irresolvable*

Despite their perceived efficacy, barrier methods were seldom seen at the study site. Fires could have been underreported as research visits were by day and yet the majority of fires are set to deter nocturnal species, i.e. bush pig. However, little evidence of fire was observed during farm surveys. A primary reason for this anomaly appears to be due to financial limitations; both fences and fires are expensive to construct and maintain.

In order to build and maintain fences, a source of materials (i.e. timber and/ or wire) and labour are required (Adesina *et al.*, 1994). Fires need a regular source of firewood, which is becoming increasingly difficult to locate in this part of Masindi District (Klunne and Mugisha, 2001). Farmers, therefore, are restricted by a lack of materials and money, the same factors that the majority of interviewees state they require before they will accept a novel crop protection strategy. Lack of finance was also a primary reason for not using control measures in other studies (Alghali and Bockarie, 1994) and farmers in Uganda have indicated they are more willing to accept strategies if they do not incur any further economic or labour costs (Hill, 2000). Farmers at other sites have also stated that they regard a reduction in input (i.e. economic outlay on pest management techniques) to be more important than maximizing crop yield (Williamson *et al.*, 2003).

As previous chapters have outlined, those most affected by crop raiding are often poor, vulnerable to food shortage and have little political and social power. It is perhaps unsurprising that farmers most at risk from crop damage (i.e. previously exposed to raids and closest to animal habitat) perceive further financial or material investment to be beyond their capabilities and request assistance. However, it is interesting that one of the most vulnerable and poorest groups (those over 46) is the only social strata where several individuals are willing to try new techniques without any support. Older members of the community may be an important component of any future conflict mitigation strategy at this site. In contrast, interviewees in one of the wealthiest villages of this study, Nyakafunjo (Chapter 4), are not willing to try a novel strategy without some form of assistance. This response may indicate that local people in this area are becoming dependent upon external agencies; Nyakafunjo is the closest village to the BFP field site and thus the most exposed to international researchers and conservation funding (Babweteera, Director BFP 2006, *pers comm*). Other studies have also found that requesting assistance with crop raiding or vermin control is the most common response to this question and local people believe that outsiders will supply a 'high-technology solution' (Mengesha and Bull, 1997, Warren, 2003). Indeed, in some countries traditional practice has been abandoned in favour of "inappropriate imported technology" (Hunter, 1996, p.4). It is encouraging that farmers around BFR are willing to try new ideas, but a concern that some view donor support as a solution to their problems which hints at a 'culture of dependence' (Hill *et al.*, 2002). As Warren (2003) details, there is the possibility that "attempts by conservation organizations to empower communities via financial or development means is in fact having a negative effect in some communities" (p 264).

It should be noted that not all interviewees believe there is a solution to crop raiding; over one third of the sample state that crop raiding is irresolvable, especially when they are restricted from killing problem animals or removing animal habitat. Local people with this view tend to be those most exposed to crop damage; either previously raided during the study, with fields close to animal habitat and/ or women. Women are more likely to be responsible for food crops in this area, do most of the guarding (Taylor, 1969, Hill, 2000) and are more frequently encountered in farms than men (*pers obs*). Therefore, they are often at the 'front-line' of crop protection. The results imply that constant exposure to crop raiding wildlife makes farmers convinced that they cannot do anything to solve the issue unless they are allowed to take control of the situation, for example, remove animal habitat and/ or kill problem species[63]. It suggests that there is an acceptable threshold that farmers in rural communities have traditionally managed that is now restricted by conservation legislation.

### 7.5 Summary

The results indicate that many different crop protection methods are being utilized around BFR, however, not all are considered effective. It is interesting that highly valued strategies are often those that are inaccessible to farmers due to economic restrictions or conservation legislation. It may indicate that caution is needed in interpreting these results as perceptions of the efficacy of a strategy could be inflated if local people are prevented from accessing an intervention. However, low technology repellants and deterrents such as goat dung are available to a high proportion of the

[63] Farmers are permitted to kill 'vermin' species with specific crop protection methods if causing damage to property. However, they are prohibited from hunting. This conflicting legislation seems to cause confusion regarding permissible behaviour (Johnson, 1996, Lauridsen, 1999, Hill, 2005)

study sample (50.4% own goats, Chapter 4) and yet are rarely implemented. Further research is needed to fully understand the motivation behind the adoption of different strategies.

In conclusion:

1. The most commonly used crop protection methods around BFR are low technology and inexpensive however they are not always believed to be effective due to associated social costs

2. Techniques that permanently exclude wildlife from farms (i.e. barriers and lethal) are perceived to be the most effective. They are often not used due to economic or legislative limitations

3. A high proportion of the sample believe that crop raiding is irresolvable while the conflict is out of their control

# 8. DISCUSSION

## 8.1 Introduction

Crop raiding by large vertebrates is a significant problem to subsistence farmers around BFR and over 6km$^2$ of agricultural crops were damaged during this research study. Primates cause a high proportion of this loss; baboons, chimpanzees and monkeys eat both highly valued food produce (i.e. maize and cassava) and cash crops (i.e. tobacco and sugar cane). This can result in substantial economic and nutritional hardship to subsistence farmers. However, different primate species do not generate equal levels of damage and thus local people are exposed to varying levels of risk. For example, baboons, like bush pig, can cause extensive loss to a high number of crops at varying stages of their maturity. Monkeys, in contrast, damage few crops and their movements are dependent upon the landscape and location of trees[64]. Whilst loss to chimpanzees is negligible, they do penetrate deeper into cultivated areas than other primates and sugar cane is particularly vulnerable to their depredations.

Perhaps, therefore, it is no surprise that the majority of local people perceive crop damage by primates and other wild vertebrates to be the most significant threat to their subsistence. However, farm monitoring reveals that almost one fifth of farms were not raided and very few local people experience sustained damage at this site. Crop yield can also be dramatically reduced by insects, crop disease, domestic animals and the weather. In addition, vulnerability to raids by wild species is not inevitable but is dependent upon planting strategies and distance from the forest. So why do so many people who do not experience damage perceive the utilization of human foods by wild animals to be a severe problem in this area?

It is possible that temporal variation may influence results; this study was only conducted for three agricultural seasons and yet human-wildlife conflict at this site is persistent and ongoing. However, complaints of crop damage from farmers with little or no loss to large vertebrates has also been found in other studies (e.g. Hill, 1997, Siex

[64] Red-tailed monkeys are believed to be responsible for the majority of loss in this area and are predominately arboreal. Whilst terrestrial monkeys (e.g. vervets) do raid at this site (Hill, 1997), their damage is believed to be small as they are rarely found close to the forest (Plumptre and Reynolds, 1994)

and Struhsaker, 1999, Gillingham and Lee, 2003, Warren, 2003, Priston, 2005). It suggests that local people may have a lower tolerance for crop raiding proportional to other risks. This is particularly relevant for primates where perceptions of risk were consistently higher than actual damage. Therefore, it is important to examine factors that may impact upon the tolerance of crop raiding species around BFR.

## 8.2 Factors Influencing the Tolerance of Raiding Species around Budongo Forest Reserve

### *8.2.1 Actual Crop Loss*

Crop damage by wildlife may be less acceptable to local people because it is unpredictable, erratic and has the potential to cause substantial subsistence and economic hardship. It is also a highly visual and pervasive threat; even if a farm is not damaged, the permanent presence of the forest and its wildlife at the agricultural boundary can increase levels of perceived risk. Tolerance toward the consumption of crops by wildlife is also affected by the intensity of damage. This research supports the findings of Naughton-Treves (1996) that small, yet consistent, loss to agricultural crops is more acceptable to farmers than infrequent and 'extreme' events. For example, 'superficial' damage by insects and goats is tolerated despite the potential to considerably reduce crop yield. The consumption of human foods by primates, however, is believed to be a severe threat. If only a small proportion of farmers are vulnerable to repeated incursions and significant loss why do so many local people complain of crop damage by wild species?

The results suggest that there is a community level perception of risk which can impact on tolerance levels, a 'collective perception' that filters individual views of vulnerability (Fitchen *et al.*, 1987). In this sense, the majority of farmers are not responding to personal threat levels but that of the population as a whole. This is interesting as, traditionally, the community would have absorbed crop loss through collective cultivation and crop protection strategies[65]. However, with more recent

[65] A collective response is seen amongst larger Banyoro communities to the east of BFR but not in the predominantly migrant community where this study is based (Paterson, 2005)

emphasis on private land ownership (Taylor, 1969) this has shifted and loss tends to be managed at the individual level (Bell, 1984). This individualism can, understandably, have a negative impact upon tolerance of problem animals (Naughton-Treves and Treves, 2005) as fluctuations in social condition, and therefore coping strategies, leave farmers vulnerable to loss.

### *8.2.2 The Fluctuation and Restriction of Coping Strategies*

Perceptions of risk alter with changes in social situation irrespective of the threat (Fitchen *et al.*, 1987, Naughton-Treves and Treves, 2005). Whilst the actual risk of crop damage by wildlife may remain the same, farmers' ability to cope with loss may fluctuate. For example, many local people migrated to BFR for employment but the closure of Budongo Saw Mill Ltd has restricted job opportunities in this area[66]. Thus, the majority of families are now wholly dependent on agriculture (Hill, 2005) and local people list lack of jobs and money as key problems of living close to the forest edge. Many risk fines and imprisonment to work illegally as pit-sawyers as it is perceived to be one of the only sources of income in the area (Lauridsen, 1999). This lack of employment has had a direct impact upon the perceived risk of crop raids. As farmers become more reliant on agricultural crops, any observable and unpredictable loss is unacceptable (Boulton *et al.*, 1996, Naughton-Treves and Treves, 2005). Furthermore, the reduction in income means that local people are forced to utilize 'ineffective' crop protection strategies. However, employment is not the only social condition that can influence perceptions of crop loss. Fluctuations in land availability mean that local people are becoming dependent on a smaller potential yield. This will reduce tolerance toward crop damage and may even result in the abandonment of the farm (Naughton-Treves and Treves, 2005). Farmers are also fearful that their land will be taken from them; the removal of communities from protected areas has been well documented in the Ugandan media (Karugaba, 2005, Kiwanuka, 2005). Another significant social factor to influence tolerance and impact upon perceived ability to cope with the threat of crop damage is the restriction of traditional crop protection strategies.

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[66] It should be noted that BFP, Nyabyeya Forestry College and KSWL do employ a small number of the study sample – Chapter 4.

Whilst the consumptive use of wildlife exists around BFR, it is less common as hunting and the use of non-specific vermin control techniques in surrounding farms are prohibited (Hill, 2000). Local people state that they are restricted from killing raiding species and instead vermin populations are allowed to grow uncontrolled. It is perhaps unsurprising, therefore, that many interviewees believe the problem of crop damage by primates and other large vertebrates is irresolvable whilst limitations are imposed on them by external agencies. Farmers around BFR complain that problem animals are protected by governments under conservation law and yet authorities will not take responsibility for their damage to food crops. This research clearly demonstrates that by imposing restrictions on local people, perceptions of control and ownership are shifted to external agencies and local authorities are believed to have responsibility for managing 'their' animals (e.g. Newmark *et al.*, 1993, Naughton-Treves, 1996, Biryahwaho, 2002, Weladji and Tchamba, 2003, Hill, 2004, Osborn and Hill, 2005). This supposition is supported by statements of repeated requests for assistance.

Actual crop loss, social conditions and restrictions on coping strategies all impact upon tolerance toward wild species utilizing human foods. However, they also highlight that crop damage by primates and other large vertebrates is tolerated differently to other risks due to pervasive people-state conflict (Knight, 2000a). Crop raiding by wild animals has come to symbolise the forest itself and intense frustration with those who restrict its use.

### *8.2.3 Symbolic Associations with the Forest and External Control*

Crop raiding by primates, like damage from other large vertebrates, termites, birds and the weather represents the symbolic permeation of external forces into domestic space. Local people perceive external issues to be more significant and effective strategies to deal with their presence often advocate permanent exclusion. In this sense, the agricultural domain is classified differently from nature and local people refer to a distinct boundary between domestic and wild that should not be breached (Knight, 2000a). Views of problem primates support this analogy. Baboons are described in very negative terms due to the perception of their incursions as planned, terrestrial attacks on the farm. In contrast, goats are described as neutral and their 'internal' damage negligible as they are believed to be under the control of, and reflect, the owner. Interestingly, primates may be perceived differently to other raiding species as they represent boundary crossing not just in a physical way but also in a moral and phylogenetic sense; primates embody anthropomorphic emotions and behaviour more than any other raiding animals. Whilst external issues are clearly significant to the research sample, the majority of problems are perceived to originate in one place, the forest itself.

BFR has become a symbol for external problems. In addition to crop damage by primates and other large vertebrates, the forest is believed to be responsible for sickness, land tenure issues, high risk planting strategies and a lack of employment. This association with negative influences is not new. BFR is seen as a source of fear, mystery and bloodshed by many local people; bush spirits, rebel armies and criminals[67] have all been linked with the forest (Paterson, 1991, Hill, 1997, Lauridsen, 1999). The reserve also represents the historical legacy of the British Protectorate. Whilst there is no doubt that local people originally benefited from the creation of an economic industry (the majority of them migrated to this area to work at the sawmill), it, and the preservationist conservation policies advocated during this period, effectively isolated local people from resources (Infield, 1988, Hill, 1991, IIED, 1994, Naughton-Treves, 1996). Just as environmental plans advocated a hard boundary around the forest to keep humans out, local people now wish to segregate wildlife from agricultural areas. Interestingly, it has recently been argued that the colonial authorities in this area forcefully removed local people from their farms to establish nature reserves (New Vision, 2004). However, there is evidence that people were expelled from these areas due to disease epidemics (Chapter 2). It is an example of how different stakeholders can revise reality to suit their particular perspective and how human-wildlife conflict can become a symbol of social and political tension.

[67] Criminals frequently use BFR as a cover for illegal activities i.e. theft and murder (*pers obs*).

Social conflict is often found to underpin human-wildlife conflict (Knight, 2000a). For example, the controversial wolf reintroduction programme in Yellowstone National Park has been described as a 'symbolic manifestation of a much larger social struggle' between environmentalists and advocates of the Wise Use Movement over land use in the American West (Wilson, 1997, p2). In addition, disagreement over carnivore conservation is often believed to be a ''surrogate' for broader cultural conflicts' (Primm and Clark, 1996, p1037, Kleiven *et al.*, 2004). The results of this study indicate that crop raiding wildlife around BFR has come to symbolize perceived control by external forces, for example, the government, wildlife authorities and conservation organizations.

Farmers around BFR perceive that they experience all the negative elements of living next to the forest, for example crop raiding by wildlife, but receive no benefit as they are not given any control or responsibility over the resource. As previously mentioned, the forest is perceived to be owned by those who place restrictions on its utilization; the authorities and conservation agencies (NFA, UWA and BFP). As found by Gillingham and Lee (1999), the government is believed to be preoccupied with the needs of wildlife and international organizations rather than the needs of local communities. Thus, the real issue is not wildlife *per se*, but the restrictions that are associated with the forest and its animals (Yaffee and Wondollek, 2000). Crop raiding animals have become "symbols of state intervention and coercion" (Naughton-Treves and Treves, 2005, p, 253) and their damage is not tolerated. However, risk perception is complex and influenced by many factors including the manner in which the problem is managed (Fitchen *et al.*, 1987).

Local people feel isolated and frustrated by responses of the government and authorities to crop damage. They state that the authorities have promised to help but assistance has not yet materialized. The NFA are also believed to be increasing the forest boundary thus limiting agricultural expansion and bringing wildlife closer to farms. There is no evidence to support the fact that the forest is actually increasing at the study site. In fact, personal observation suggests that the boundary of the main reserve is being slowly eroded by encroaching agriculture. The claim does, however, indicate a deepening distrust between local people and the NFA and during this study there were several angry and violent incidents between the two stakeholders (*pers obs*)[68]. Trust is a vital component in risk perception (Slovic, 1997) and local people clearly do not have confidence in Ugandan authorities to preserve their livelihoods. Unfortunately distrust of external organizations is not unusual at sites of human-wildlife conflict (e.g. Newmark *et al.*, 1993, Gillingham and Lee, 1999, Alexander, 2000). It should be noted that rural communities are able to gain some political power by complaining about raiding wildlife (Hill, 1991) and this is more significant at sites with endangered animals. The ongoing presence of international conservation organizations that are interested in the welfare of protected species e.g. chimpanzees, will ensure that human-wildlife conflict stays high on the agenda for local people.

### 8.3 Improving Conflict Mitigation around Budongo Forest Reserve

It is unlikely that human-wildlife conflict at the agricultural interface will ever be eliminated (Newmark *et al.*, 1994, Madhusudan, 2003). Rather there is a need to reduce damage to acceptable levels and elevate tolerance for raiding species (Naughton-Treves, 1996, 2001, Fall and Jackson, 2002, DEFRA, 2004, Osborn and Hill, 2005). This study has contributed to this endeavour by identifying key factors that increase actual and perceived risk.

Actual vulnerability to crop raids by primates is influenced by the distance of cultivation from forested areas and planting strategies. Clearly the most effective way to lessen the threat is to either switch to cultivating non-edible produce or move the farm away from the forest edge. However, these solutions are not practical for the subsistence farmer that has no alternative source of income. In addition, local people would rather secure the field boundary and permanently exclude primates from the farm. Whilst this would decrease the risk of raids, the adaptability and protected status

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[68] Unfortunately the NFA inherited much of this distrust from its predecessor, the Forest Department, where there was a history of corruption and conflict with local people (Hamilton, 1984, Lauridsen, 1999, Bush *et al.*, 2004).

of many species means it is unlikely to be a feasible solution. Therefore, it is important to find a way to reduce the actual and perceived threat without compromising conservation legislation or increasing the costs to individual farmers (Hill, 2000, Weladji and Tchamba, 2003). A potential resolution is the development of cultural practices (IIED, 1994, Jackson and Wangchuk, 2004); traditional systems already present in the community that can be adapted to protect fields from crop raiding by primates. Perhaps the most immediately accessible and successful method is to improve non-lethal crop protection techniques i.e. guarding.

*8.3.1 Guarding*

Guarding (or an elevated level of human presence) substantially reduces the risk of crop raiding by primates and other wild species. However, its high labour cost means that local people perceive it as unsuccessful. Perhaps the most efficient method of reducing the amount of labour required by each individual farmer without losing the efficacy of the method would be to create a guard patrol (Warren, 2003, Priston, 2005). This would build on the cultural role of community hunting in this area; men could be employed in a joint arrangement with the local community and wildlife authorities/ NGOs to patrol fields and to scare raiding animals from agricultural areas[69]. It is well documented that raiding primates are more fearful of men than women or children, particularly known hunters or those carrying weapons (King and Lee, 1987, Else, 1991, Strum, 1994, Hill, 2000, Warren, 2003, Osborn and Hill, 2005, Priston, 2005). The patrol would need to vary the time of day that visits were made and the length of time of the tour of duty as primates will quickly habituate to repetitive action (Priston, 2005). This technique could be further developed by clearing a small buffer between the forest and fields around which the patrol could move. It would be the responsibility of the patrol to ensure that this was maintained.

NFA have recently proposed the clearance of a 20m strip inside the forest boundary for a community woodlot scheme (Reynolds 2006, *pers comm*). This is likely to prove

[69] It is interesting to note that crop raiding by primates was seldom observed during this study despite the fact that baboons, chimpanzees and monkeys were frequently seen or heard on the forest edge. Some farmers would joke that our 'patrol' was an effective deterrent.

popular with local people as they will have a potential source of fuelwood (eucalyptus) and money. However, it will require constant monitoring and guarding; eucalyptus can be vulnerable from depredations by wild species and termite infestation (Bell, 1984, Mitchell, 2002). A high level of human activity may deter wildlife but as the plantation matures animals may use it as an extension of natural habitat (e.g. Ganzhorn and Abraham, 1991, Hill, 1997). A cleared area would be a more effective deterrent from primates (Else, 1991, Horrocks and Baulu, 1994) and may also reduce perceived risk as the cleared buffer would enclose farms and form a symbolic barrier protecting agricultural produce.

To further develop the efficacy of guarding it is important to detect incursions by primates and repel animals from the area quickly but without causing injury or death to the individual. Early warning devices have proved effective with elephants (Sitati *et al.*, 2005), however primates can be difficult to observe and they are too small and agile to trigger trip-wire systems (Priston, 2005). Perhaps the most obvious solution at this site is to use dogs to assist with guarding patrols.

Whilst there is some ambiguity regarding the efficacy of using dogs for crop protection generally (Chapter 7), many studies have suggested that they could be useful deterrents against primate species; macaques, baboons, bonobos and langurs all fear canids (e.g. Bernstein, 1968, Nishida, 1972, Dittus, 1977, Else, 1991, Biquand *et al.*, 1994, Warren, 2003, Priston, 2005)[70]. In Japan, stray dogs are being trained to keep monkeys out of fields thereby limiting the expense of culls to either species (Mainichi Daily News 2006). Despite 10% of farmers owning dogs at the study site, few people discussed the possibility of using them as a crop protection strategy. This has also been found in Nigeria (Warren, 2003) and may be due to the illegality of hunting with dogs or the high Muslim population in that area[71]. Although there is a culture of dog keeping amongst ethnic groups around BFR, it is not clear if this could extend to a crop

[70] Sprague (2002) describes how monkeys appear to adapt their behaviour to the type of dog present. Feral dogs elicit a higher level of fear than guard dogs (the latter are usually tied and thus limited in their response to monkey incursions).

[71] Dogs are perceived to be 'unclean' by many Muslims

protection strategy. Guard dogs would need to be thoroughly trained (Priston, 2005) and well looked after in order to repel primate species without causing them harm; currently many dogs in this area of Uganda are poorly fed and therefore are not of an adequate size or condition to threaten some large vertebrate species (Hill 2006, *pers comm*). Using dogs as a crop protection strategy around BFR requires further research but may have some potential if integrated with a package of non-lethal techniques. It may also increase the value of guarding at this site as currently farmers are unconvinced of its efficacy.

*8.3.2 Hunting*

It is vital that farmers perceive positive benefits to living close to BFR otherwise they will neither respect legislation nor tolerate crop damage to wildlife. This concern has been recently confirmed by hunters who, under pressure from conservation groups, have agreed to give up laying snares in the forest. In the absence of any perceived benefits from BFR, 23% of them have shifted to illegal pit-sawing (Tumusiime, 2004). This is of major concern, as it indicates the strength of economic attachment to the forest, the ease of movement from one illegal activity to another and the lack of options at this site (Hill, 2004). A recognizable incentive (often financial) is a key factor in the development and support of conservation initiatives in economically deprived areas (e.g. Infield, 1988, Hill, 1991, Heinen, 1993, Newmark *et al.*, 1993, Little, 1994, Sekhar, 1998, Gillingham and Lee, 1999, Alexander, 2000, Mishra *et al.*, 2003, Okello, 2005). However, BFR is in a very different situation to the majority of human-wildlife conflict sites; it is not a National Park and therefore there is currently little potential for employment or sharing tourist revenue[72]. A more successful mitigation strategy will be one that allows the utilization of forest products in exchange for managing the resource and enforcing conservation policy.

[72] There are two ecotourist sites in BFR (see Appendix 1). Busingiro is still accepting a small number of visitors and JGI Uganda have recently begun to redevelop Kaniyo-Pabidi (JGI, 2006). Ecotourism and chimpanzee tracking started in the early 1990s but never reached full potential or generated much money for the community (Lauridsen, 1999). Unfortunately, both initiatives are quite a distance from the villages in this study therefore it is unlikely that they will have any major impact upon their livelihoods.

Collaborative forest management does hold some potential (Bush *et al.*, 2004) and initial success has been seen in communities at other sites of conflict (Deziderius 2005, *pers comm*). However, perhaps the greatest incentive for increased tolerance at this site with regard to problem species would be the legalization of bush meat hunting for specific large vertebrates. Bush pig would be ideal for a programme of this nature as they thrive in disturbed habitat, are considered vermin at the site and are prolific breeders (Vercammen *et al.*, 1993). Pigs are a popular source of meat in this area and have a good market for sale (Johnson, 1996). Bush pig hunting has been suggested at other sites in Uganda, and, with proper controls[73], could enable local people to manage crop depredation whilst protecting endangered species (Naughton-Treves, 1998, 1999). One concern would be that populations of other species may be targeted; i.e. duiker are also a popular source of protein (Johnson, 1996). It may also reinforce the view of the forest as an inexhaustible resource (Lauridsen, 1999, Tumusiime, 2004). However, guard patrols could take responsibility for managing the programme and ensuring harvest limits are sustainable. In addition, they would need to check that benefits are distributed equally amongst affected farmers as this can have a negative impact upon attitudes (Gillingham and Lee, 1999, Alexander, 2000, Weladji and Tchamba, 2003).

### *8.3.3 Buffer Crops*

Buffer crops have great potential at this site and in all areas of people-primate conflict (Boulton *et al.*, 1996, Naughton-Treves, 1996, Saj *et al.*, 2001, Lee and Priston, 2005). A barrier of non-palatable vegetation could be grown at the forest edge in order to physically separate wild species from valued food stuffs, thus reducing the actual and perceived risk of raids. As buffer crops work in a similar way to fences and fires, it is hoped that farmers would perceive the strategy to have potential efficacy. Farmers would also be able to gain access to an income-generating scheme that would not only protect valued crops from loss to primates but also return money. Tea and wheat (specifically a locally named variety called 'Maloko') have been found to have potential as buffer crops in other areas of Uganda (Andama and McNeilage, 2003,

[73] Specific and traditional hunting techniques (i.e. spear and bow and arrow) would need to be employed to ensure that protected species were not harmed.

Plumptre *et al.*, 2003a).[74] It is not clear whether either of these crops would grow well around BFR; for example, tea (*Camellia sinensis*) grows better at higher altitudes and with an even distribution of rainfall (Yayock *et al.*, 1988), neither of which are present in this area. However, a number of crops did not get damaged by primates or other large vertebrates during this study and thus demonstrate potential as buffers.

Pineapples are hardy, can cope well with drought and are very versatile; they can be eaten fresh or canned, juiced or used in preserves (Yayock *et al.*, 1988). There is also a growing market for dried fruit in Uganda (Agona *et al.*, 2002). Pineapples are eaten by many local people and are frequently used by tourist venues, hotels and large organizations. In addition, they are low-lying so will not interfere with the sightlines of guarding farmers trying to protect their remaining agricultural produce from depredations by primates and other wildlife (Warren, 2003). They do, however, require a lot of sunlight (Yayock *et al.*, 1988). Shade from the forest edge may hamper their development so they may only be an appropriate buffer near fallow or bush areas. There are also occasional reports of primates eating pineapples (Else, 1991, Hill 2006, *pers comm*) although it was not seen in this study despite the availability of the fruit. Further research needs to be undertaken into specific planting strategies to understand if the low levels of observed damage on pineapples are due to avoidance or the fact that they are regularly planted in low risk areas.

Chilli peppers were also not eaten by primates or other large vertebrates around BFR and thus have potential as a buffer crop around BFR. Like pineapples, chillies are a low lying crop and thus it is difficult for a large animal to move through them undetected. They are also rain fed (Yayock *et al.*, 1988) therefore would mature at the same time as highly vulnerable food crops such as maize. Chilli peppers are seldom used in rural Ugandan cooking but have a good international market. In addition, derivatives from the plant have been found to be effective in repelling wildlife from agricultural areas (Chalise, 2000/1, Osborn, 2002). In Zambia, an entire company has

[74] Although it should be noted that tea can cause environmental problems as it needs a large amount of wood to dry the leaves (Plumptre *et al.*, 2003a)

been established to grow and market chilli based products whose income support the training of farmers to use non-lethal chill based repellants (Elephant Pepper Development Trust[75]).

The disadvantage of using buffer crops as a method of conflict mitigation is that, like any cash crop, their economic value is dependent upon international sales. Local people around BFR are suspicious of market led programmes; farmers in this area have experienced significant financial loss due to fluctuations in the global price of cotton, coffee, rubber and tobacco (Baker, 1971, Nsambu, 2005). Furthermore, local people state that expectations have been raised by NGOs encouraging the growth of 'new' cash crops (Tumusiime, 2004) e.g. moringa, vanilla and ocimum. Farmers are yet to see a substantial return for any of these interventions. It may also be difficult for vulnerable farmers (i.e. those that have small fields and no alternative source of food or income) to convert a suitable amount of land to a buffer crop. This is a significant problem as these farmers are also less likely to be able to cope with any damage by primates and other large vertebrates. It is possible that wealthier stakeholders (i.e. conservation organizations or national authorities) could buy or lease land on behalf of the community with the agreement that local people should be responsible for the maintenance of any buffer crop and subsequently a share of the profits. However, this would necessitate the sale or lease of land owned either by NFA or local people. In addition, maintenance agreements would need to be explicit and formalized to ensure that everyone was aware of their roles and responsibilities.

All the above mitigation strategies have potential to reduce human-wildlife conflict and raise tolerance of wildlife around BFR. However, the participation of the affected community will have a significant impact upon their success. As this study demonstrates, if local people feel restricted by legislation and see no participatory role in conflict mitigation, it is likely they would rather eradicate/ isolate wildlife than tolerate its presence (Hill, 1991).

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*8.3.4 Participation*

A key component of success in the development of effective mitigation strategies is the active participation of local people (IIED, 1994). This can assist in the design of an appropriate, sustainable intervention and encourage responsibility and the equitable distribution of benefits (IIED, 1994, Jackson and Wangchuk, 2004). Whilst the suggestions in this chapter warrant further attention, it is important that those most affected by crop raiding take an integral role in identifying and planning future interventions at this site. Failure to involve key stakeholders can have a significant impact upon the success of conservation initiatives (e.g. Brown and Wyckoff-Baird, 1992, IIED, 1994, Little, 1994, Alexander, 2000, Jackson *et al.*, 2001, Biryahwaho, 2002, Webber *et al.*, In Press). This is especially important around BFR where local people have negative perceptions of the forest, its wildlife and those authorities responsible for its conservation.

Participatory projects can open channels of communication between wildlife authorities, research organizations and local people. Previous research has indicated that even a low level of contact between these stakeholders can have a positive impact upon attitudes to wildlife (Newmark *et al.*, 1993). This is important around BFR where farmers feel excluded from decision making and do not trust authorities. Furthermore, it is hoped that local people will recognize that they must bear some responsibility for the origin and mitigation of the conflict (Madhusudan, 2003). In India and Kenya, participatory IPM projects have led to greater confidence in decision making and farmers are more likely to tolerate some crop damage (Williamson *et al.*, 2003). This awareness of personal responsibility may also assist in reducing the culture of dependence that is developing at this site.

Perhaps an effective way to initiate and develop mitigation in the villages around BFR is to conduct participatory trials. This will gather valuable empirical data for future intervention strategies (e.g. optimum buffer widths and responses of primates and other large vertebrates to guarding patrols and dogs) in addition to demonstrating the efficacy of methods to local people. Understandably resource-poor farmers will be reluctant to invest in novel techniques if they are not proven (IIED, 1994, Webber *et al.*, In Press). If wildlife authorities or conservation organizations were able to fund these trials it would also show a degree of commitment to addressing the issue. However, it is important that local people are fully integrated into the monitoring and evaluation process to avoid the trials from becoming another externally driven intervention.

The majority of strategies suggested here rely on a collective approach to mitigation (Naughton-Treves and Treves, 2005). There is some evidence that local people would rather have benefits targeted towards individuals (see Mishra *et al.*, 2003, Tumusiime, 2004). The disadvantages of community level action has been seen at other sites, for example, a school built near Bwindi Impenetrable National Park to assist vulnerable families was so far from the forest edge that attendance was impractical (Archabald and Naughton-Treves, 2001). It is hoped that participatory development and management of trials would ensure that any strategy works on both an individual and community level. However, it is unlikely that any initiative around BFR will be able to be managed entirely by local people (at least not in its initial stages). This is not a 'homogenous' community (IIED, 1994, Little, 1994, Hill *et al.*, 2002, Hill, 2004) but a multi-ethnic group formed by a, now-defunct, capitalist industry (Lauridsen, 1999). It is not possible to just 'hand back' access to resources as the majority of local people have never had a traditional relationship with the forest (Lauridsen, 1999, Naughton-Treves, 1999). Rather, co-management, using the well-established local council system, may prove to be the most effective way to develop mitigation strategies (Johnson, 1996, Naughton-Treves, 1996, 1999). In contrast with Paterson (2005), this study found local councilors to be interested in the issues of crop raiding and engaged in discussions with other stakeholders.

## 9. CONCLUSION

The continued encroachment of agriculture into forested areas will increase the interaction between people and primates and thus the potential for conflict. Crop raiding needs to be viewed as an integral part of primate feeding ecology (Richard *et al.*, 1989, Naughton-Treves *et al.*, 1998) as the extensive removal of tree cover at sites of endemism is likely to increase dependence upon human foods. The global expansion of the cash crop industry in developing countries will further intensify this conflict. This is a concern for both subsistence farmers and conservationists; species' populations are likely to decline thus increasing legislation on their protection and local people risk the loss of valuable food and income without being able to utilize strategies that are perceived to be effective. This study has demonstrated the importance of research into the dynamics of the forest-agriculture boundary as crop damage by primates and other large vertebrates around BFR represents a significant actual and perceived risk[76].

Whilst it is not appropriate to extrapolate the results of this study to all human-wildlife conflict scenarios, comparison with other sites will assist in the identification of key factors that impact upon vulnerability toward damage and tolerance of raiding wild species. Through the utilization of GIS technology, I was able to highlight several variables at the farm level which will assist in the development of low risk planting strategies and effective crop protection. However, future research should incorporate a more detailed analysis of biotic factors that could influence damage; for example, density of raids, species home range size, availability of natural forage, crop planting combinations, distance from water sources and climate. This must be explored alongside studies examining social conditions; I have clearly demonstrated that the impact of crop loss fluctuates in the context of a changing social, cultural and environmental landscape.

[76] This is with the exception of domestic species. Whilst reducing damage from these animals would undoubtedly improve the success of subsistence farming in this area, local people do not perceive they generate the same risk as wild species. Focusing on livestock could heighten the conflict with wild animals as farmers are likely to believe that, yet again, their concerns are not being taken seriously

Local people perceive that external authorities are restricting access to the few perceptible benefits of the reserve. This attitude is exacerbated by the fact that BFR is managed for the extraction of resources; benefits are believed to go to outsiders and local farmers perceive that they only experience the negative elements of living close to the forest i.e. crop damage. I posit that a low cost, low technology strategy with direct financial benefits for those most affected may be required to mitigate conflict at this site. As this thesis documents, this is not a novel suggestion and others have reached similar conclusions (see Discussion). However, it serves to demonstrate the need for extensive research into the efficacy of traditional and novel crop protection strategies. Whilst exploratory studies are important for gaining baseline data on the actual and perceived risk of human-wildlife conflict, there is a real need to take the next step and conduct applied research. This study is part of a concerted effort to examine human-wildlife conflict around BFR; another PhD student is currently at the site and, using information from this research, has begun to evaluate non-lethal intervention strategies for repelling baboons from agricultural areas. This will not only contribute to our understanding of baboon behaviour and their response to various stimuli, it will also demonstrate to farmers that their views are being taken seriously. This coordination is vital; too often research studies are relegated to being merely an academic exercise.

There is no panacea for human-wildlife conflict but effective mitigation will need to be co-managed by the numerous stakeholders that have an interest in this site (i.e. wildlife authorities, conservation organizations, NFA and local people). The following recommendations may assist to both reduce damage and/or raise tolerance in this area:

1. Devise low risk planting strategies that are acceptable to local farmers and build upon traditional methods. Ensure that those most vulnerable to loss are included, especially women and older members of the community (local people/ conservation organizations)
2. Ensure domestic animals are kept securely tethered away from agricultural areas. Whilst this must not be stressed as the only solution to crop raiding (see page 189) it could be used as part of a larger mitigation programme (local people)
3. Create participatory education programmes that emphasize the importance of the forest to local people's livelihoods and reward those individuals/ groups who have

made a difference to local conservation efforts[77] (local people/ conservation organizations/ wildlife authorities).

4. Increase the employment opportunities for local people in forest based industries. This would improve village development, utilize a wealth of skills and experience, and create a financial incentive for adhering to conservation practices (wildlife authorities/ NFA).
5. Begin participatory trials of crop protection strategies e.g. buffer crops, community guarding, and deterrence methods. Ensure that long term funding is in place prior to initiating the trials (local people/ conservation organizations/ wildlife authorities).
6. Develop collaborative forest management programmes so that local people gain a recognisable financial benefit from the forest (local people/ NFA).
7. Undertake research and initiate partnerships with development organizations to improve social conditions amongst the local population, for example, through better medical facilities and sustainable farming methods. This could improve livelihoods and thus reduce the perceived threat of wildlife populations (development organizations/ conservation organizations/ wildlife authorities/ NFA).

A small group of subsistence farmers carry the cost of conserving internationally important wildlife species (Naughton-Treves, 1996). It is important that we find ways of mitigating the conflict both for their future and that of the animals depending on them.

[77] A formal recognition programme could be initiated that is acknowledged by local political structures and has symbolic importance through an award ceremony and a prize that is valued locally/ assists with further sustainable development and conservation practice e.g. the presentation of tree saplings.

# REFERENCES


(1998). *Morningside Declaration, Environmental Leaders Forum*. 15 May: New York.

(2003). *World Parks Congress Recommendation 20: Preventing and Mitigating Human-Wildlife Conflicts, IUCN Benefits Beyond Boundaries Conference*. 8-17 September: Durban.

(2005). Police Probe Kinyara Fire. *New Vision,* 14 February.

(2006). Abandoned Dogs to be Trained to Fight Off Pesky Monkeys in Akita World Heritage Area. *Mainichi Daily News,* 15 February.

Adesina, A. A., Johnson, D. E. and Heinrichs, E. A. (1994). Rice pests in the Ivory Coast, West Africa: farmers' perceptions and management strategies. *International Journal of Pest Management* 40, pp. 293-299.

Agona, J. A., Nabawanuka, J. and Kalunda, P. (2002). *A Market Overview of the Dried Fruit Sector in Uganda*. National Post Harvest Programme/ KARI [Online]. Retrieved on 10 August 2006 from: www.foodnet.cgiar.org/projects/projects.htm

Aipanjiguly, S., Jacobson, S. K. and Flamm, R. (2003). Conserving Manatees: knowledge, attitudes and intentions of boaters in Tampa Bay, Florida. *Conservation Biology* 17, pp. 1098-1105.

Alexander, S. E. (2000). Resident Attitudes towards Conservation and Black Howler Monkeys in Belize: the Community Baboon Sanctuary. *Environmental Conservation* 27, pp. 341-350.

Alghali, A. M. and Bockarie, A. (1994). Cultural-Practices and Perceptions in Sweet-Potato Farming and Their Implications for Pest-Management in Southern Sierra-Leone. *International Journal of Pest Management* 40, pp. 27-30.

Andama, E. and McNeilage, A. (2003). *Integrated Wild Vertebrate Pest Management Around Two Tropical Forest Parks in Uganda*. Paper presented at the International Conference on Integrated Pest Management.

Archabald, K. and Naughton-Treves, L. (2001). Tourism revenue-sharing around national parks in Western Uganda: early efforts to identify and reward local communities. *Environmental Conservation* 28, pp. 135-149.

ASA (1999). *Ethical Guidelines for Good Research Practice.* Association of Social Anthropologists of the UK and Commonwealth. [Online]. Retrieved on 12 May 2006 from: http://www.theasa.org/downloads/Ethical_guidelines.pdf

Baker, P. R. (1971). Agricultural Changes in Bunyoro 1954-68. In: Ominde, S. H., (ed.) *Studies in East African Geography and Development.* Heinemann Educational Books Ltd, pp. 123-136.

Barnes, A. and Hill, G. J. E. (1992). Estimating Kangaroo Damage to Winter Wheat Crops in the Bungunya District of Southern Queensland. *Wildlife Research* 19, pp. 417-427.

Barnett, L. and Emms, C. (2002). Baboons and Conflicts with People. *Daily Observer, The Gambia,* 9 May.

Barrett, R. H. and Birmingham, G. H. (1994). Wild Pigs. In: Hygnstrom, S. E., Timm, R. M. and Larson, G. E., (ed.) *Prevention and Control of Wildlife Damage.* Lincoln: University of Nebraska, pp. 65-70.

BBC (2006a). *New Overture to Uganda's Rebels.* [Online]. Retrieved on 17 May 2006 from: http://news.bbc.co.uk/1/hi/world/africa/4990086.stm

BBC (2006b). *UN Warns World on Africa Drought.* [Online]. Retrieved on 12 August from: http://news.bbc.co.uk/1/hi/world/africa/4744812

Beier, P. (1991). Cougar Attacks on Humans in the United States and Canada. *Wildlife Society Bulletin* 19, pp. 403-412.

Bell, D. R. (1981). *Lecture Notes on Tropical Medicine.* Oxford: Blackwell Scientific Publications.

Bell, R. H. V. (1984). The Man-Animal Interface: an assessment of crop damage and wildlife control. In: Bell, R. H. V. and McShane-Caluzi, E., (ed.) *Conservation and Wildlife Management in Africa.* Malawi: US Peace Corps, pp. 387-416.

Bender, R. and Lange, S. (1998). *What's Wrong with Arguments Against Multiplicity Adjustments.* Letter to the Editor, British Medical Journal [Online]. Retrieved on 2 June from: www.bmj.bmjjournals.com/cgi/eletters/316/7139/1236

Bernstein, I. S. (1968). The Lutong of Kuala Selangor. *Behaviour* 33, pp. 1-16.

Bhima, R. (1998). Elephant Status and Conflict with Humans on the Western Bank of Liwonde National Park, Malawi. *Pachyderm* 25, pp. 74-80.

Biquand, S., Boug, A., Biquand-Guyot, V. and Gautier, J.-P. (1994). Management of Commensal Baboons in Saudi Arabia. *Revue D Ecologie-La Terre Et La Vie* 49, pp. 213-222.

Biryahwaho, B. (2002). Community Perspectives Towards Management of Crop Raiding Animals: experiences of CARE-DTC with communities living adjacent to Bwindi Impenetrable and Mgahinga Gorilla National Parks, southwest Uganda. In: Hill, C. M., Osborn, F. V. and Plumptre, A. J., (ed.) *Human-Wildlife Conflict: identifying the problem and possible solutions.* Albertine Rift Technical Reports Series 1, Wildlife Conservation Society, pp. 46-57.

Blair, J. A. S., Boon, G. G. and Noor, N. M. (1979). Conservation or Cultivation: the confrontation between the Asian Elephant and Land Development in Penninsular Malaysia. *Land Development Digest* 2, pp. 25-58.

Bloor, M., Frankland, J., Thomas, M. and Robson, K. (2001). *Focus Groups in Social Research.* London: Sage Publications Ltd.

Bolwig, N. (1959). A Study of the Behaviour of the Chacma Baboon, *Papio ursinus. Behaviour* 14, pp. 136-163.

Boulton, A. M., Horrocks, J. A. and Baulu, J. (1996). The Barbados Vervet Monkey (*Cercopithecus aethiops sabaeus*): changes in population size and crop damage 1980-1994. *International Journal of Primatology* 17, pp. 831-844.

Bradley, E. H., Pletscher, D. H., Bangs, E. E., Kunkel, K. E., Smith, D. W., Mack, C. M., Meier, T. J., Fontaine, J. A., Niemeyer, C. C. and Jimenez, M. D. (2005). Evaluating Wolf Translocation as a Nonlethal Method to Reduce Livestock Conflicts in the Northwestern United States. *Conservation Biology* 19, pp. 1498-1508.

Brend, S. (1999). *Baboon Slaughterhouse Plan Killed for Now.* International Primate Protection League [Online]. Retrieved on May 2001 from: www.ippl.org/899brend2/htm

Brennan, E. J., Else, J. G. and Altmann, J. (1985). Ecology and Behaviour of a Pest Primate: ververt monkeys in a tourist-lodge habitat. *African Journal of Ecology* 23, pp. 35-44.

Brenner, K. (2005). Coyotes get a Reprieve: West Marin ranchers cut damage from predators the humane way. *Marin Independent Journal,* 13 November.

Brooks, A. C. and Buss, I. O. (1962). Past and Present Status of the Elephant in Uganda. *Journal of Wildlife Management* 26, pp. 38-50.

Brooks, J. E., Ahmad, F., Hussain, I. and Khan, M. H. (1989). The Agricultural Importance of the Wild Boar (*Sus Scrofa* L.) in Pakistan. *Tropical Pest Management* 35, pp. 278-281.

Brown, M. and Wyckoff-Baird, B. (1992). *Designing Integrated Conservation and Development Projects.* Washington DC: Biodiversity Support Program of the World Wildlife Fund, The Nature Conservancy and the World Resources Institute.

Brown, T. L., Decker, D. J. and Dawson, C. P. (1978). Willingness of New York Farmers to Incur White-Tailed Deer Damage. *Wildlife Society Bulletin* 6, pp. 235-239.

Bryman, A. (2001a). Ethnography and Participant Observation. In: Bryman, A., (ed.) *Social Research Methods.* Oxford: Oxford University Press, pp. 289-310.

Bryman, A. (2001b). Focus Groups. In: Bryman, A., (ed.) *Social Research Methods.* Oxford: Oxford University Press, pp. 335-353.

Bryman, A. (2001c). Interviewing in Qualitative Research. In: Bryman, A., (ed.) *Social Research Methods.* Oxford: Oxford University Press, pp. 312-333.

Bush, G., Nampindo, S., Aguti, C. and Plumptre, A. (2004). *The Value of Uganda's Forests: a livelihoods and ecosystems approach.* Kampala: Wildlife Conservation Society (Albertine Rift Programme), EU Forest Resources Management & Conservation Programme and National Forestry Authority (Uganda).

Busharizi, P. and Kasita, I. (2006). Huge New Oil Well in Lake Albert. *The New Vision,* 23 June.

Castro, R. and Soini, P. (1978). Field Studies on *Saguinus mystax* and Other Callitrichids in Amazonian Peru. In: Kleiman, D. G., (ed.) *The Biology and Conservation of the Callitrichidae.* Washington: Smithsonian Institute Press.

Chalise, M. K. (2000/1). Crop Raiding by Wildlife, Especially Primates, and Indigenous Practices for Crop Protection in Lakuwa Area, East Nepal. *Asian Primates* 7, pp. 4-9.

Chambers, R. (2002). *Participatory Workshops: a sourcebook of 21 sets of ideas and activities.* London: Earthscan.

Chapman, C. (1995). Primate Seed Dispersal: coevolution and conservation implications. *Evolutionary Anthropology* 4, pp. 74-82.

Chapman, C. A. and Peres, C. A. (2001). Primate Conservation in the New Millenium: the role of scientists. *Evolutionary Anthropology* 10, pp. 16-33.

Cheney, D. L. and Wrangham, R. W. (1987). Predation. In: Smuts, B. B., Cheney, D. L., Seyfarth, R. M., Wrangham, R. W. and Struhsaker, T. T., (ed.) *Primate Societies.* Chicago: University of Chicago Press, pp. 227-239.

Chitere, P. O. and Omolo, B. A. (1993). Farmers' Indigenous Knowledge of Crop Pests and their Damage in W. Kenya. *International Journal of Pest Management* 39, pp. 126-132.

Chou, Y. (1997). *Exploring Spatial Analysis in Geographic Information Systems.* Santa Fe: Onward Press.

Clarke, J. R. (1953). The Hippopotamus in Gambia, West Africa. *Journal of Mammalogy* 34, pp. 299-315.

Cleary, E. C., Dolbeer, R. A. and Wright, S. E. (2006). *Wildlife Strikes to Civil Aircraft in the United States.* National Wildlife Strike Database Series Report 12. Washington DC: Federal Aviation Administration.

Coblentz, B. E. (1978). The Effects of Feral Goats (*Capra hircus*) on Island Ecosystems. *Biological Conservation* 13, pp. 279-286.

Coleman, J. D. (1993). The Integration of Management of Vertebrate Pests in New-Zealand. *New Zealand Journal of Zoology* 20, pp. 341-345.

Conelly, W. T. (1987). Perception and Management of Crop Pests among Subsistence Farmers in South Nyanza, Kenya. In: Tait, J. and Napompeth, B., (ed.) *Management of Pests and Pesticides: farmers' perceptions and practices.* London: Westview Press, pp. 198-209.

Conforti, V. A. and de Azevedo, F. C. C. (2003). Local Perceptions of Jaguars (*Panthera onca*) and Pumas (*Puma concolor*) in the Iguacu National Park Area, South Brazil. *Biological Conservation* 111, pp. 215-221.

Conover, M. R. (1994). Perceptions of Grass-Roots Leaders of the Agricultural Community about Wildife Damage on their Farms and Ranches. *Wildlife Society Bulletin* 22.

Conover, M. R. and Decker, D. J. (1991). Wildlife Damage to Crops: perceptions of agriccultural and wildlife professionals in 1957 and 1987. *Wildlife Society Bulletin* 19, pp. 46-52.

Cousins, D. (1978). Man's Exploitation of the Gorilla. *Biological Conservation* 13, pp. 287-297.

Cowlishaw, G. (1997). Trade-Offs between Foraging and Predation Risk in a Desert Baboon Population. *Animal Behaviour* 53, pp. 667-686.

Craven, S. R. and Hygnstrom, S. E. (1994). Deer. In: Hygnstrom, S. E., Timm, R. M. and Larson, G. E., (ed.) *Prevention and Control of Wildlife Damage.* Lincoln: University of Nebraska, pp. 25-40.

CTV (2005). *Bear Attack Closes Banff National Park Trails.* Canadian Television News [Online]. Retrieved on 10 August 2006 from: www.ctv.ca/servlet/articlenews/story/ctvnews/20050829/banff_bearattackclosures_20050829

D'Alessandro, A., Benowitz, N. L., Muzi, G., Eisner, M. D., Filiberto, S., Fantozzi, P., Montanari, L. and Abbritti, G. (2001). Systematic Nicotine Exposure in Tobacco Harvesters. *Archives of Environmental Health* 56, pp. 257-263.

Dardaillon, M. (1987). Seasonal Feeding Habits of the Wild Boar in a Mediterranean Wetland, the Camargue (Southern France). *Acta Theriologica* 32, pp. 389-401.

De Boer, W. F. and Baquete, D. S. (1998). Natural Resource Use, Crop Damage and Attitudes of Rural People in the Vicinity of the Maputo Elephant Reserve, Mozambique. *Environmental Conservation* 25, pp. 208-218.

de Merode, E., Homewood, K. and Cowlishaw, G. (2004). The Value of Bushmeat and other Wild Foods to Rural Households Living in Extreme Poverty in Democratic Republic of Congo. *Biological Conservation* 118, pp. 573-581.

DEFRA (2004). *Rabbits.* Rural Development Series Technical Advice Note 01. DEFRA Rural Development Service & the Central Science Laboratory.

DEFRA (2005). *Moles.* Rural Development Service Technical Advice Note 03. DEFRA Rural Development Service.

Dhillon, M. K., Singh, R., Naresh, J. S. and Sharma, H. C. (2005). The Melon Fruit Fly, *Bactrocera cucurbitae:* a review of its biology and management. *Journal of Insect Science* 5, pp. 1-16.

Dittus, W. P. J. (1977). The Social Regulation of Population Density and Age-Sex Distribution in the Toque Monkey. *Behaviour* 63, pp. 281-322.

Dixon, J., Gulliver, A. and Gibbon, D. (2001). Introduction. In: (ed.) *Farming Systems and Poverty: improving farmers' livelihoods in a changing world.* Rome and Washington DC: FAO and World Bank, pp. 1-35.

Donnelly, C. A., Woodroffe, R., Cox, D. R., Bourne, J., Gettinby, G., Le Fevre, A. M., McInerney, J. P. and Morrison, W. I. (2003). Impact of Localized Badger Culling on Tuberculosis Incidence in British Cattle. *Nature* 426, pp. 834-837.

Doya, D. M. (2006). Kenyan-Led Group Wins Bid to Buy Kinyara. *The East African,* 7 August.

Drake, D. and Grande, J. (2002). Assessment of Wildlife Depredation to Agricultural Crops in New Jersey. *Journal of Extension* 40.

Drever, E. (1995). *Using Semi-Structured Interviews in Small-Scale Research: a teacher's guide.* Glasgow: Scottish Council for Research in Education.

Durand, H., Zanetti, M., Agnesi, S., Aguilar-Manjarrez, P., Crescenzi, B., Pieper, G. and Caparrini, F. (2004). *Geographic Information Systems in Sustainable Development.* Prepared by the Geographic Information Systems Group, Environment and Natural Resources Services (SDRN), UN Food and Agriculture Organisation, Research, Extension and Training Division. [Online]. Retrieved on 9 January 2006 from: www.fao.org/sd/eidirect/gis/eigis000.htm

Eggeling, W. J. (1947). Observations on the Ecology of the Budongo Rain Forest, Uganda. *Journal of Ecology* 34, pp. 20-87.

Eley, D. and Else, J. (1984). Primate Pest Problems in Kenya Hotels and Lodges. *International Journal of Primatology* 5, pp. 334-334.

Eley, R. M., Strum, S. C., Muchemi, G. and Reid, G. D. F. (1989). Nutrition, Body Condition, Activity Patterns and Parasitism of Free Ranging Troops of Olive Baboons (*Papio anubis*) in Kenya. *American Journal of Primatology* 18, pp. 209-219.

Ellis, E. J. (1999). *Cynocephalus variegatus*. [Online]. Retrieved on 09 August 2006 from: www.animaldiversity.com.unmz.umich.edu/site/accounts/information/cynocephalus_variegatus.html

Else, J. G. (1991). Non-Human Primates as Pests. In: Box, H. O., (ed.) *Primate Responses to Environmental Change*. London: Chapman & Hall.

Etya'ale, D. (2002). Eliminating onchocerciasis as a public health problem: the beginning of the end. *British Journal of Opthalmology* 86, pp. 844-846.

Ezealor, A. U. and Giles, R. H. (1997). Vertebrate pests of a Sahelian wetland agro-ecosystem: perceptions and attitudes of the indigenes and potential management strategies. *International Journal of Pest Management* 43, pp. 97-104.

Fall, M. W. and Jackson, W. B. (2002). The Tools and Techniques of Wildlife Damage Management - changing needs: an introduction. *International Biodeterioration & Biodegradation* 49, pp. 87-91.

Ferrari, S. F. and Diego, V. H. (1995). Habitat Fragmentation and Primate Conservation in the Atlantic Forest of Eastern Minas Gerais, Brazil. *Oryx* 29, pp. 192-196.

Fitchen, J., Heath, J. and Fessenden-Raden, J. (1987). Risk Perception in Community Context; a case study. In: Johnson, B. and Covello, V., (ed.) *The Social and Cultural Construction of Risk: essays on risk selection and perception.* AA Dordrecht: D Reidel, pp. 31-54.

Fitzgibbon, C. D., Mogaka, H. and Fanshawe, J. H. (1995). Subsistence Hunting in Arabuko-Sokoke Forest, Kenya and its Effect on Mammal Populations. *Conservation Biology* 9, pp. 1116-1126.

Foote, K. E. and Lynch, M. (1995). *Geographic Information Systems as an Integrating Technology: context, concepts and definitions.* The Geographer's Craft Project. Boulder: University of Colorado.

Forthman-Quick, D. L. (1986). Controlling Primate Pests: the feasibility of conditioned taste aversion. In: Taub, D. M. and King, F. A., (ed.) *Current Perspectives in Primate Social Dynamics.* New York: Van Nostrand Reinhold Company, pp. 252-273.

Fox, D. L. (2006). *Orycteropus afer (Aardvark)*. [Online]. Retrieved on 6 July 2006 from:

www.animaldiversity.unmz.umich.edu/site/accounts/information/Orycteropus_afer.html

Fox, J., Yonzon, P. and Podger, N. (1996). Mapping Conflicts between Biodiversity and Human Needs in Langtang National Park, Nepal. *Conservation Biology* 10, pp. 562-569.

Gadd, M. E. (2005). Conservation Outside of Parks: attitudes of local people in Laikipia, Kenya. *Environmental Conservation* 32, pp. 50-63.

Ganzhorn, J. U. and Abraham, Y. P. (1991). Possible Role of Plantations for Lemur Conservation in Madagascar: food for folivorous species. *Folia Primatologica* 56, pp. 171-176.

Geisser, H. and Reyer, H. U. (2004). Efficacy of Hunting, Feeding and Fencing to Reduce Crop Damage by Wild Boars. *Journal of Wildlife Management* 68, pp. 939-946.

Geist, H. J. (1999). Global Assessment of Deforestation Related to Tobacco Farming. *Tobacco Control* 8, pp. 18-28.

Gilham, B. (2000). *The Research Interview*. London: Continuum.

Gillingham, S. and Lee, P. C. (1999). The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous Game Reserve, Tanzania. *Environmental Conservation* 26, pp. 218-228.

Gillingham, S. and Lee, P. C. (2003). People and Protected Areas: a study of local perceptions of wildlife crop-damage conflict in an area bordering the Selous Game Reserve, Tanzania. *Oryx* 37, pp. 316-325.

Gonzalez-Kirchner, J. P. and Sainz de la Maza, M. (1998). Primates Hunting by Guaymi Amerindians in Costa Rica. *Human Evolution* 13, pp. 15-19.

Goodman, S. (2003). Oryzorictes, Mole Tenrec or Rice Tenrec. In: Goodman, S. M. and Benstead, J. P., (ed.) *The Natural History of Madagascar*. Chicago: University of Chicago Press, pp. 1281.

Goyal, P. S. (2001). Man-Eating Leopards: status and ecology of leopard in Pauri Garhwal, India. *Carnivore Damage Prevention News* 3, pp. 9-10.

Hamilton, A. C. (1984). *Deforestation in Uganda*. Nairobi: Oxford University Press.

Harding, R. S. O. (1984). Primates of the Killini Area, northwest Sierra Leone. *Primate Conservation* 4, pp. 32-34.

Hawthorne, D. W. (1994). Armadillos. In: Hygnstrom, S. E., Timm, R. M. and Larson, G. E., (ed.) *Prevention and Control of Wildlife Damage.* Lincoln: University of Nebraska.

Heinen, J. T. (1993). Park-People Relations in Kosi Tappu Wildlife Reserve, Nepal: a socio-economic analysis. *Environmental Conservation* 20, pp. 25-34.

Henderson, R. F. (1994). Moles. In: Hygnstrom, S. E., Timm, R. M. and Larson, G. E., (ed.) *Prevention and Control of Wildlife Damage.* Lincoln: University of Nebraska.

Hill, C. M. (1997). Crop-Raiding by Wild Vertebrates: the farmer's perspective in an agricultural community in western Uganda. *International Journal of Pest Management* 43, pp. 77-84.

Hill, C. M. (2000). Conflict of Interest Between People and Baboons: crop raiding in Uganda. *International Journal of Primatology* 21, pp. 299-315.

Hill, C. M. (2002). People, Crops and Primates: a conflict of interests. In: Hill, C. M., Osborn, F. V. and Plumptre, A. J., (ed.) *Human-Wildlife Conflict: identifying the problem and possible solutions.* Albertine Rift Technical Report Series 1. Wildlife Conservation Society, pp. 60-67.

Hill, C. M. (2004). Farmers' Perspectives of Conflict at the Wildlife-Agriculture Boundary: some lessons learned from African subsistence farmers. *Human Dimensions of Wildlife* 9, pp. 279-286.

Hill, C. M. (2005). People, Crops and Primates: a conflict of interests. In: Paterson, J. D. and Wallis, J., (ed.) *Commensalism and Conflict: the human-primate interface.* Norman, Oklahoma: American Society of Primatologists, pp. 40-59.

Hill, C. M., Osborn, F. V. and Plumptre, A. J. (2002). *Human-Wildlife Conflict: identifying the problem and possible solutions.* Albertine Rift Technical Reports Series vol 1, Wildlife Conservation Society.

Hill, K. A. (1991). Zimbabwe's Wildlife Conservation Regime: rural farmers and the state. *Human Ecology* 19, pp. 19-34.

Hoare, R. E. (1999). Determinants of Human-Elephant Conflict in a Land-Use Mosaic. *Journal of Applied Ecology* 36, pp. 689-700.

Hockings, K. (2006). *Temporal Patterns of Crop-Raiding in the Bossou Chimpanzees, West Africa.* Poster Presentation at the 21st International Primatological Society Congress. Entebbe, 27-30 June.

Holstein, J. A. and Gubrium, J. F. (1995). *The Active Interview.* California: Sage Publications Inc.

Hone, J. (1995). Spatial and Temporal Aspects of Vertebrate Pest Damage with Emphasis on Feral Pigs. *Journal of Applied Ecology* 32, pp. 311-319.

Horrocks, J. A. and Baulu, J. (1988). Effects of Trapping on the Vervet (*Cercopithecus aethiops sabaeus*) Population in Barbados. *American Journal of Primatology* 15, pp. 223-233.

Horrocks, J. A. and Baulu, J. (1994). Food Competition Between Vervets (*Cercopithecus aethiops sabaeus*) and Farmers in Barbados: implications for management. *Revue D Ecologie-La Terre Et La Vie* 49, pp. 281-294.

Humle, T. (2003). Chimpanzees and Crop Raiding in West Africa. In: Kormos, R., Boesch, C., Bakarr, M. I. and Butynski, T. M., (ed.) *West African Chimpanzees Status and Survey Conservation Action Plan.* Gland: IUCN, pp. 147-150.

Hunter, D. (1996). Traditional Pest Control and Agricultural Development in the Atolls of the Maldives. *Indigenous Knowledge and Development Monitor* 4.

IIED (1994). *Whose Eden? An Overview of Community Approaches to Wildlife Management.* London: IIED.

Imam, E., Yahya, H. S. A. and Malik, I. (2002). A successful mass translocation of commensal rhesus monkeys Macaca mulatta in Vrindaban, India. *Oryx* 36, pp. 87-93.

Infield, M. (1988). Attitudes of a Rural Community towards Conservation and a Local Conservation Area in Natal, South Africa. *Biological Conservation* 45, pp. 21-46.

INIBAP (2006). *A Growing Epidemic.* International Network for the Improvement of Banana and Plantain. [Online]. Retrieved on 14 August 2006 from: www.inibap.org/pdf/epidemic

IUCN (2006). *Caesalpinia decapetala.* Global Invasive Species Database. [Online]. Retrieved on 12 August 2006 from: www.issg.org/database/species/ecology

Jackson, J. J. (1994). Opossums. In: Hygnstrom, S. E., Timm, R. M. and Larson, G. E., (ed.) *Prevention and Control of Wildlife Damage.* Lincoln: University of Nebraska, pp. 59-63.

Jackson, R., Hillard, D. and Wangchuk, R. (2001). Encouraging Local Participation in Efforts to Reduce Livestock Depredation in Snow Leopard and Wolf in Ladakh, India. *Carnivore Damage Prevention News* 4, pp. 2-6.

Jackson, R. M. and Wangchuk, R. (2004). A Community-Based Approach to Mitigating Livestock Depredation by Snow Leopards. *Human Dimensions of Wildlife* 9, pp. 307-315.

JGI (2006). *Kaniyo-Pabidi, Budongo Forest Reserve Eco-Tourist Project.* The Jane Goodall Institute Africa Programs. [Online]. Retrieved on 21 September 2006 from: www.janegoodall.org/africa-programs/programs/kibale-national-park.asp

Jhala, Y. V. (1993). Damage to *Sorghum* Crop by Blackbuck. *International Journal of Pest Management* 39, pp. 23-27.

Johnson, K. (1996). Hunting in the Budongo Forest, Uganda. *SWARA*, pp. 13-15.

Jones, C. and Sabater-Pi, J. (1968). Comparative Ecology of *Cercocebus Albigena* (Gray) and *Cercocebus Torquatus* (Kerr) in Rio Muni, West Africa. *Folia Primatologica* 9, pp. 99-113.

Kagoro-Rugunda, G. (2004). Crop Raiding Around Lake Mburo National Park, Uganda. *African Journal of Ecology* 42, pp. 32-41.

Kano, T. (1971). Distribution of the Primates on the Eastern Shore of Lake Tanganyika. *Primates* 12, pp. 281-304.

Karugaba, M. (2005). NFA Evicts 10,000 in Bundibugyo. *The Monitor,* 25 April 2005.

Kellert, S. R. (1985). Social and Perceptual Factors in Endangered Species Management. *Journal of Wildlife Management* 49, pp. 528-538.

King, F. A. and Lee, P. C. (1987). A Brief Survey of Human Attitudes to a Pest Species of Primate - *Cercopithecus aethiops. Primate Conservation* 8, pp. 82-84.

Kingdon, J. (1997). *The Kingdon Field Guide to African Mammals.* London: Academic Press.

Kinzey, W. G., Norconk, M. A. and Alvarez-Cordero, E. (1988). Primate Survey of Eastern Bolivar, Venezuala. *Primate Conservation* 9, pp. 66-70.

Kiwanuka, F. (2005). NFA to Evict 600 Families. *The New Vision,* 9 May 2005.

Kleiven, J., Bjerke, T. and Kaltenborn, B. P. (2004). Factors Influencing the Social Acceptability of Large Carnivore Behaviours. *Biodiversity and Conservation* 13, pp. 1647-1658.

Klunne, W. and Mugisha, C. (2001). Responses of Rural Households to the Decline of Woodfuel Collecting Areas: case study in an expanding sugarcane area in the Masindi District of Uganda. *Energia* 4, pp. 7-9.

Knight, J. (1999). Monkeys on the Move: The Natural Symbolism of People-Macaque Conflict in Japan. *Journal of Asian Studies* 58, pp. 622-647.

Knight, J. (2000a). Introduction. In: Knight, J., (ed.) *Natural Enemies: people-wildlife conflicts in Anthropological perspective.* London: Routledge, pp. 1-35.

Knight, J. (2000b). *Natural Enemies: people-wildlife conflicts in Anthropological perspective.* London: Routledge.

Kolowski, J. M. and Holekamp, K. E. (2006). Spatial, Temporal and Physical Characteristics of Livestock Depredations by Large Carnivores along a Kenyan Reserve Border. *Biological Conservation* 128, pp. 529-541.

Kreuger, R. A. and Casey, M. A. (2000). *Focus Groups: a practical guide for applied research.* Thousand Oaks: Sage Publications Inc.

Krishnamani, R. (1994). Diet Composition of the Bonnet Macaque. *Tropical Biodiversity* 2, pp. 285-301.

KSWL (2006). *Kinyara Sugar.* [Online]. Retrieved on 21 August 2006 from: www.kinyara.co.ug

Langley, R. L. (2005). Animal-Related Fatalities in the United States - an update. *Wilderness and Environmental Medicine* 16, pp. 67-74.

Lauridsen, M. (1999). *Workers in a Forest: understanding the complexity of incorporating local people in modern management.* MSc thesis, Anthropology Department. University of Copenhagen.

Le Lay, G., Clergeau, P. and Hubert-Moy, L. (2001). Computerized map of risk to manage wildlife species in urban areas. *Environmental Management* 27, pp. 451-461.

Lee, P. C., Brennan, E. J., Else, J. G. and Altmann, J. (1986). Ecology and Behaviour of Vervet Monkeys in a Tourist Lodge. In: Else, J. G. and Lee, P. C., (ed.) *Primate Ecology and Conservation.* Cambridge: Cambridge University Press, pp. 229-236.

Lee, P. C. and Priston, N. E. C. (2005). Human Attitudes to Primates: perceptions of pests, conflict and consequences for primate conservation. In: Paterson, J. D. and Wallis, J., (ed.) *Commensalism and Conflict: the human-primate interface.* Norman, Oklahoma: American Society of Primatologists, pp. 1-23.

Little, P. D. (1994). The Link Between Local Participation and Improved Conservation: a review of issues and experiences. In: Western, D., Wright, R. M. and Strum, S. C., (ed.) *Natural Connections: perspectives in community-based conservation.* Washington DC: Island Press, pp. 347-372.

Lizarralde, M. (2002). Ethnoecology of Monkeys among the Bari of Venezuala: perception, use and conservation. In: Fuentes, A. and Wolfe, L. D., (ed.) *Primates Face to Face: the conservation implications of human-nonhuman primate interconnections.* Cambridge: Cambridge University Press, pp. 85-100.

Loker, C. A., Decker, D. J. and Schwager, S. J. (1999). Social Acceptability of Wildlife Management Actions in Suburban Areas: three case studies from New York. *Wildlife Society Bulletin* 27, pp. 152-159.

Madden, F. (1999). *The Management of Human-Mountain Gorilla (Gorilla gorilla beringei) in Bwindi Impenetrable National Park.* International Gorilla Conservation Program, Washington DC

Madhusudan, M. D. (2003). Living Amidst Large Wildlife: livestock and crop depredation by large mammals in the interior villages of Bhadra Tiger Reserve, south India. *Environmental Management* 31, pp. 466-475.

Malo, J. E., Suarez, F. and Diez, A. (2004). Can We Mitigate Animal-Vehicle Accidents Using Predictive Models? *Journal of Applied Ecology* 41, pp. 701-710.

Maples, W. R., Maples, M. K., Greenhood, W. F. and Walek, M. L. (1976). Adaptations of Crop-raiding Baboons in Kenya. *American Journal of Physical Anthropology* 45, pp. 309-316.

Marchal, V. (2006). Primate Crop Raiding: a study of local perceptions in four villages in North Sumatra, Indonesia. *Primate Eye* 88, pp. 23.

Marriott, H. (1999). Micro-Demography of a Farming Population of Western Uganda: a preliminary analysis investigating population pressure on the Budongo Forest Reserve. *Soc Biol Hum Affairs* 64, pp. 1-11.

Martinez, R. A., Moscarella, R. A., Aguilera, M. and Marquez, E. (2000). Update on the Status of the Margarita Island Capuchin, *Cebus apella margaritae*. *Neotropical Primates* 8, pp. 34-35.

Marvin, G. (2000). The Problem of Foxes: legitimate and illegitimate killing in the English countryside. In: Knight, J., (ed.) *Natural Enemies: people-wildlife conflicts in Anthropological perspective.* London: Routledge, pp. 189-211.

Mascarenhas, A. (1971). Agricultural Vermin in Tanzania. In: Ominde, S. H., (ed.) *Studies in East African Geography and Development.* Berkley: University of California Press, pp. 259-267.

McCann, C. (1933). Notes on Some Indian Macaques. *Journal of the Bombay Natural History Society* 36, pp. 796-810.

Mengesha, A. and Bull, M. (1997). Starting with Local Knowledge in Participatory Research. In: VanVeldhuizen, L., Waters-Bayer, A., Ramirez, R., Johnson, D. A. and Thompson, J., (ed.) *Farmer's Research in Practice: lessons from the field.* London: Intermediate Technology Publication, pp. 115-126.

Michelmore, F. (1994). Keeping Elephants on the Map: case studies of the application of GIS for conservation. In: Miller, R. I., (ed.) *Mapping the Diversity of Nature.* London: Chapman & Hall.

Mishra, C., Allen, P., McCarthy, T., Madhusudan, M. D., Bayarjargal, A. and Prins, H. H. T. (2003). The Role of Incentive Programs in Conserving the Snow Leopard. *Conservation Biology* 17, pp. 1512-1520.

Mitchell, J. and Slim, H. (1991). Listening to Rural People in Africa: the semi-structured interview in rapid rural appraisal. *Disasters* 15, pp. 68-72.

Mitchell, J. D. (2002). Termites as Pests of Crops, Forestry, Rangeland and Structures in Southern Africa and their Control. *Sociobiology* 40, pp. 47-69.

Mohnot, S. M. (1971). Ecology and Behaviour of the Hanuman Langur, *Presbytis entellus* (Primates: Cercopithecidae) Invading Fields, Gardens and Orchards around Jodhpur, Western India. *Tropical Ecology* 12, pp. 237-249.

Morgan, D. L. (1998). *The Focus Group Guidebook.* Thousand Oaks: Sage Publications Inc.

Mullin, M. H. (1999). Mirrors and Windows: sociocultural studies of human-animal relationships. *Annual Review of Anthropology* 28, pp. 201-224.

Musau, J. M. and Strum, S. C. (1984). Response of Wild Baboon Troops to Incursion of Agriculture at Gilgil, Kenya. *International Journal of Primatology* 5, pp. 364.

Musinguzi, J., Kirungi, W., Opio, A., Madraa, E., Biryahwaho, B. and Mulumba, N. (2003). *STD/ HIV/ AIDS Surveillance Report.* STD/AIDS Control Programme, Ugandan Ministry of Health. Kampala.

Muwanga, D. (2005). Kinyara to Inject sh47b in Expansion. *New Vision,* 25 October.

Naughton-Treves, L. (1996). *Uneasy Neighbours: wildlife and farmers around Kibale National Park, Uganda.* PhD Thesis, University of Florida.

Naughton-Treves, L. (1997). Farming the Forest Edge: vulnerable places and people around Kibale National Park, Uganda. *The Geographical Review* 87, pp. 27-46.

Naughton-Treves, L. (1998). Predicting Patterns of Crop Damage by Wildlife around Kibale National Park, Uganda. *Conservation Biology* 12, pp. 156-168.

Naughton-Treves, L. (1999). Whose Animals? A History of Property Rights to Wildlife in Toro, Western Uganda. *Land Degradation and Development* 10, pp. 311-328.

Naughton-Treves, L. (2001). Farmers, Wildlife and the Forest Fringe. In: Weber, W., White, L. J. T., Vedder, A. and Naughton-Treves, L., (ed.) *African Rain Forest Ecology and Conservation.* New Haven, Conn.: Yale University, pp. 369-384.

Naughton-Treves, L., Mena, J. L., Treves, A., Alvarez, N. and Radeloff, V. C. (2003). Wildlife Survival Beyond Park Boundaries: the impact of slash-and-burn agriculture and hunting on mammals in Tambopata, Peru. *Conservation Biology* 17, pp. 1106-1117.

Naughton-Treves, L. and Treves, A. (2005). Sociological Factors Shaping Local Support for Wildlife: crop raiding by elephants and other wildlife in Africa. In: Woodroffe, R., Thirgood, S. and Rabinowitz, A., (ed.) *People and Wildlife: conflict or coexistence?* Cambridge: Cambridge University Press, pp. 252-277.

Naughton-Treves, L., Treves, A., Chapman, C. and Wrangham, R. (1998). Temporal Patterns of Crop-Raiding by Primates: linking food availability in croplands and adjacent forest. *Journal of Applied Ecology* 35, pp. 596-606.

Nepal, S. K. and Weber, K. E. (1995). Prospects for Coexistence: wildlife and local people. *Ambio* 24, pp. 238-245.

Newmark, W. D., Leonard, N. L., Sariko, H. I. and Gamassa, D. M. (1993). Conservation Attitudes of Local People Living Adjacent to Five Protected Areas in Tanzania. *Biological Conservation* 63, pp. 177-183.

Newmark, W. D., Manyanza, D. N., Gamassa, D. G. M. and Sariko, H. I. (1994). The Conflict between Wildlife and Local People Living Adjacent to Protected Areas in Tanzania: human density as a predictor. *Conservation Biology* 9, pp. 249-255.

Nishida, T. (1972). Preliminary Information of the Pygmy Chimpanzees (*Pan paniscus*) of the Congo Basin. *Primates* 13, pp. 415-425.

Norusis, M. J. (1999). *SPSS Regression Models 10.0.* SPSS, Inc.

NPWS (2000). *Endangered Long-nosed Bandicoot Population at North Head.* Threatened Species Information, New South Wales. [Online]. Retrieved on 18 August 2006 from: www.nationalparks.nsw.gov.au/PDFs/TSprofile_Long_nosed_bandicoot_North Head_pop.pdf

Nsambu, H. (2005). Bunyoro Farmers Sue BAT. *The New Vision,* 1st April.

Nyangabyaki, B. (1991). *The Notion of "Food Self-Sufficient Uganda": a critical re-examination.* Paper presented at a workshop organised by the Population Movements, Famine and Community Response Conference, The Centre for the Study of Administration Relief (CSAR), New Delhi, 9-13 January.

Nzita, R. and Mbaga, N. (1997). *Peoples and Cultures of Uganda.* Kampala: Fountain Publishers.

Oates, J. F., Anadu, P. A., Gadsby, E. L. and Werre, J. L. (1992). Sclater's Guenon. *National Geographic Research and Exploration* 8, pp. 476-491.

Oerke, E. C. and Dehne, H. W. (2004). Safeguarding Production - losses in major crops and the role of crop protection. *Crop Protection* 23, pp. 275-285.

Okello, M. M. (2005). Land Use Changes and Human-Wildlife Conflicts in the Amboseli Area, Kenya. *Human Dimensions of Wildlife* 10, pp. 19-28.

Oli, M. K., Taylor, I. R. and Rogers, M. E. (1994). Snow Leopard (Panthera uncia) Predation of Livestock: an assessment of local perceptions in the Annapurna Conservation Area, Nepal. *Biological Conservation* 68, pp. 63-68.

O'Meilia, M. E., Knopf, F. L. and Lewis, J. C. (1982). Some Consequences of Competition between Prairie Dogs and Beef Cattle. *Journal of Range Management* 35, pp. 580-585.

Osborn, F. V. (2002). Capsicum oleoresin as an Elephant Repellent: field trials in the communal lands of Zimbabwe. *Journal of Wildlife Management* 66, pp. 674-677.

Osborn, F. V. and Hill, C. M. (2005). Techniques to Reduce Crop Loss: human and technical dimensions in Africa. In: Woodroffe, R., Thirgood, S. and Rabinowitz, A., (ed.) *People and Wildlife: conflict or co-existence?* Cambridge: Cambridge University Press, pp. 72-85.

Oyaro, H. O. and Strum, S. C. (1984). Shifts in Foraging Strategies as a Response to the Presence of Agriculture in a Troop of Wild Baboons at Gilgil, Kenya. *International Journal of Primatology* 5, pp. 371.

Parry, D. and Campbell, B. (1992). Attitudes of Rural Communities to Animal Wildlife and its Utilization in Chobe Enclave and Mbabe Depression, Botswana. *Environmental Conservation* 19, pp. 245-252.

Paterson, J. D. (1991). The Ecology and History of Uganda's Budongo Forest. *Forest & Conservation History* 35, pp. 179-187.

Paterson, J. D. (2005). Primate and Human Interaction in Masindi District, Uganda. In: Paterson, J. D. and Wallis, J., (ed.) *Commensalism and Conflict: the human-primate interface.* Norman, Oklahoma: American Society of Primatologists, pp. 76-89.

Paterson, J. D. and Wallis, J. (2005). *Commensalism and Conflict: the human-primate interface.* Norman, Oklahoma: American Society of Primatologists.

Patterson, B. D., Kasiki, S. M., Selempo, E. and Kays, R. W. (2004). Livestock Predation by Lions (*Panthera leo*) and Other Carnivores on Ranches Neighbouring Tsavo National Park, Kenya. *Biological Conservation* 119, pp. 507-516.

Peine, J. D. (2001). Nuisance Bears in Communities:strategies to reduce conflict. *Human Dimensions of Wildlife* 6, pp. 223-237.

Perneger, T. V. (1998). What's Wrong with Bonferroni Adjustments. *British Medical Journal* 316, pp. 1236-1238.

Petter, J. J. (1977). The Aye-Aye. In: II, P. R. and Bourne, G. M., (ed.) *Primate Conservation.* New York: Academic Press, pp. 37-57.

Pirta, R. S., Gadgil, M. and Kharshikar, A. V. (1997). Management of the Rhesus Monkey *Macaca mulatta* and Hanuman Langur *Presbytis entellus* in Himachal Pradesh, India. *Biological Conservation* 79, pp. 97-106.

Plumptre, A. J. (2002). Crop Raiding around the Parc National des Volcans, Rwanda: farmer's attitudes and possible links with poaching. In: Hill, C. M., Osborn, F. V. and Plumptre, A. J., (ed.) *Human-Wildlife Conflict: identifying the problem and possible solutions.* Albertine Technical Report Series vol 1. Wildlife Conservation Society, pp. 78-87.

Plumptre, A. J., Arnold, M. and Nkuutu, D. (2003a). *Conservation Action Plan for Uganda's Chimpanzees 2003-2008.*

Plumptre, A. J., Laporte, N. and Devers, D. (2003b). Threats to Sites. In: Plumptre, A. J., Behangana, M., Ndomba, E., Davenport, T., Kahindo, C., Kityo, R., Ssegawa, P., Eilu, G., Nkuutu, D. and Owiunji, I., (ed.) *The Biodiversity of the Albertine Rift.* Albertine Rift Technological Report 3, pp. 82-88.

Plumptre, A. J. and Reynolds, V. (1994). The Effect of Selective Logging on the Primate Populations in the Budongo Forest Reserve, Uganda. *Journal of Applied Ecology* 31, pp. 631-641.

Poirier, F. E. (1971). The Nilgiri Langur: a threatened species. *Zoonooz* 49, pp. 10-16.

Poole, D. W., McKillop, I. G., Western, G., Hancocks, P. J. and Packer, J. J. (2002). Effectiveness of an Electric Fence to Reduce Badger (*Meles meles*) Damage to Field Crops. *Crop Protection* 21, pp. 409-417.

Pretty, J. N., Gujit, I., Thompson, J. and Scoones, I. (1995). *Participatory Learning and Action: a trainer's guide.* London: International Institute for Environment and Development.

Primm, S. A. and Clark, T. W. (1996). Making Sense of the Policy Process for Carnivore Conservation. *Conservation Biology* 10, pp. 1036-1045.

Priston, N. (2005). *Crop-raiding by Macaca ochreata brunnescens in Sulawesi: reality, perceptions and outcomes for conservation.* PhD Thesis. Biological Anthropology, University of Cambridge.

Putman, R. J. (1989). Introduction. In: Putman, R. J., (ed.) *Mammals as Pests.* London: Chapman and Hall, pp. 1-20.

Quiatt, D., Reynolds, V. and Stokes, E. J. (2002). Snare Injuries to Chimpanzees (*Pan troglodytes*) at 10 Study Sites in East and West Africa. *African Journal of Ecology* 40, pp. 303-305.

Quinn, C. H., Huby, M., Kiwasila, H. and Lovett, J. C. (2003). Local Perceptions of Risk to Livelihood in Semi-Arid Tanzania. *Journal of Environmental Management* 68, pp. 111-119.

Raik, D. B., Siemer, W. F. and Decker, D. J. (2005). Intervention and Capacity Considerations in Community-Based Deer Management: the stakeholders' perspective. *Human Dimensions of Wildlife* 10, pp. 259-272.

Rao, K. S., Maikhuri, R. K., Nautiyal, S. and Saxena, K. G. (2002). Crop Damage and Livestock Depredation by Wildlife: a case study from Nanda Devi Biosphere Reserve, India. *Journal of Environmental Management* 66, pp. 317-327.

Reynolds, V. (2003). Editorial and Stop Press. *Budongo Forest Project Newsletter* 5, pp. 1-2.

Reynolds, V. (2005). *The Chimpanzees of The Budongo Forest.* Oxford: Oxford University Press.

Reynolds, V., Wallis, J. and Kyamanywa, R. (2003). Fragments, Sugar and Chimpanzees in Masindi District, Western Uganda. In: Marsh, L. K., (ed.)

*Primates in Fragments: ecology and conservation.* Kluwer Academic/ Plenum Publishers, pp. 309-320.

Richard, A. F., Goldstein, S. J. and Dewar, R. E. (1989). Weed Macaques: the evolutionary implications of macaque feeding ecology. *International Journal of Primatology* 10, pp. 569-594.

Riley, S. J. and Decker, D. J. (2000). Risk Perception as a Factor in Wildlife Stakeholder Acceptance Capacity for Cougars in Montana. *Human Dimensions of Wildlife* 5, pp. 50-62.

Robbins, P. (1995). *Tropical Commodities and their Markets: a guide and directory.* London: TWIN Ltd.

Rogers, A. (2005). Lack of Interest dents UPE. *The New Vision,* 9 May. p25.

Ross, C. and Hill, C. M. (2006). *Non-Human Primates as Pests: variation in primate species and human cultures.* Paper presented at the 21st International Primatological Society Congress. Entebbe, 25-30 June.

Rossman, G. B. and Rallis, S. F. (1998). *Learning in the Field: an introduction to qualitative research methods.* California: Sage Publications Inc.

Rowe, N. (1996). *The Pictorial Guide to the Living Primates.* Charlestown, Rhode Island: Pogonias Press.

Saj, T., Sicotte, P. and Paterson, J. D. (1999). Influence of human food consumption on the time budget of vervets. *International Journal of Primatology* 20, pp. 977-994.

Saj, T. L., Sicotte, P. and Paterson, J. D. (2001). The conflict between vervet monkeys and farmers at the forest edge in Entebbe, Uganda. *African Journal of Ecology* 39, pp. 195-199.

Salafsky, N. (1993). Mammalian Use of a Buffer Zone Agroforestry System Bordering Gunung Palung National Park, West Kalimantan, Indonesia. *Conservation Biology* 7, pp. 928-933.

Schley, L. and Roper, T. J. (2003). Diet of wild boar Sus scrofa in Western Europe, with particular reference to consumption of agricultural crops. *Mammal Review* 33, pp. 43-56.

Scott, R. and Scott, H. (1994). Crocodile Bites and Traditional Beliefs in Korogwe District, Tanzania. *British Medical Journal* 309, pp. 1961-1962.

Segurado, P., Araujo, M. B. and Kunin, W. E. (2006). Consequences of Spatial Autocorrelation for Niche-Based Models. *Journal of Applied Ecology* 43, pp. 433-444.

Seiler, A. (2005). Predicting Locations of Moose-Vehicle Collisions in Sweden. *Journal of Applied Ecology* 42, pp. 371-382.

Sekhar, N. U. (1998). Crop and Livestock Depredation Caused by Wild Animals in Protected Areas: the case of Sariska Tiger Reserve, Rajasthan, India. *Environmental Conservation* 25, pp. 160-171.

Shepard, G. H. (2002). Primates in Matsigenka Subsistence and World View. In: Fuentes, A. and Wolfe, L. D., (ed.) *Primates Face to Face: the conservation implications of human-nonhuman primate interconnections.* Cambridge: Cambridge University Press, pp. 101-136.

Sicotte, P. and Uwengeli, P. (2002). Reflections on the Concept of Nature and Gorillas in Rwanda: implications for conservation. In: Fuentes, A. and Wolfe, L. D., (ed.) *Primates Face to Face: the conservation implications of human-nonhuman interconnections.* Cambridge: Cambridge University Press, pp. 163-182.

Siegel, S. and Castellan Jr, N. J. (1988). *Nonparametric statistics for the Behavioral Sciences.* London: McGraw-Hill Book Company.

Siex, K. S. and Struhsaker, T. T. (1999). Colobus monkeys and coconuts: a study of perceived human- wildlife conflicts. *Journal of Applied Ecology* 36, pp. 1009-1020.

Sitati, N. W., Walpole, M. J. and Leader-Williams, N. (2005). Factors Affecting Sustainability of Farms to Crop Raiding by African Elephants: using a predictive model to mitigate conflict. *Journal of Applied Ecology* 42, pp. 1175-1182.

Sitati, N. W., Walpole, M. J., Smith, R. J. and Leader-Williams, N. (2003). Predicting spatial aspects of human-elephant conflict. *Journal of Applied Ecology* 40, pp. 667-677.

Slovic, P. (1987). Perception of Risk. *Science* 236, pp. 280-285.

Slovic, P. (1997). Public Perception of Risk. *Journal of Environmental Health* 59, pp. 22-23.

Smith, K., Barrett, C. B. and Box, P. W. (2000). Participatory Risk Mapping for Targeting Research and Assistance: with an example from east African pastoralists. *World Development* 28, pp. 1945-1959.

SOCP (2006). *Sumatran Orangutans - Persecution as Pests*. [Online]. Retrieved on 10 July 2006 from: www.sumatranorangutan.org/site_mawas/uk/background/pag/back_general.htm

Somers, C. M. and Morris, R. D. (2002). Birds and Wine Grapes: foraging activity causes small-scale damage patterns in single vineyards. *Journal of Applied Ecology* 39, pp. 511-523.

Southwick, C. H. and Siddiqi, M. E. (1998). The Rhesus Monkey's Fall From Grace. In: Ciochon, R. I. and Nisbett, R. A., (ed.) *The Primate Anthology: essays on primate behaviour, ecology and conservation from natural history.* New Jersey: Prentice Hall, pp. 211-218.

Southwick, C. H., Siddiqi, M. F. and Oppenheimer, J. R. (1983). Twenty-Year Changers in Rhesus Monkey Populations in Agricultural Areas of Northern India. *Ecology* 64, pp. 434-439.

Sprague, D. S. (2002). Monkeys in the Backyard: encroaching wildlife and rural communities in Japan. In: Fuentes, A. and Wolfe, L. D., (ed.) *Primates Face to Face: the conservation implications of human-nonhuman interconnections.* Cambridge: Cambridge University Press, pp. 254-272.

Ssonko, K. (2004). Uranium Existence Confirmed. *New Vision, 25 October.*

Starin, D. (1989). Threats to the Monkeys of the Gambia. *Oryx* 23, pp. 208-214.

Stephenson, C. M., MacKenzie, M. L., Edwards, C. and Travis, J. M. J. (2006). Modelling Establishment Probabilities of an Exotic Plant, *Rhododendron ponticum*, invading a heterogenous, woodland landscape using logistic regression with spatial autocorrelation. *Ecological Modelling* 193, pp. 747-758.

Strum, S. C. (1994). Prospects for Management of Primate Pests. *Revue D Ecologie-La Terre Et La Vie* 49, pp. 295-306.

Sukumar, R. (1990). Ecology of the Asian Elephant in Southern India .2. Feeding-Habits and Crop Raiding Patterns. *Journal of Tropical Ecology* 6, pp. 33-53.

Sutherland, W. J., Pullin, A. S., Dolman, P. M. and Knight, T. M. (2004). The Need for Evidence-Based Conservation. *Trends in Ecology & Evolution* 19, pp. 305-308.

Sutton, R., Prince, R., Bowes-Lyon, D. and Ferguson, J. (1995). *Sickness and its Treatment in Masindi District*. Budongo Forest Project, Report no. 26.

Tappen, N. C. (1960). Problems of Distribution and Adaptation of the African Monkeys. *Current Anthropology* 1, pp. 91-120.

Tattersall, I. (1998). Lemurs of the Comoro Archipelago: status of *Eulemur mongoz* on Moheli and Anjouan, and of *Eulemur fulvus* on Mayotte. *Lemur News* 3, pp. 15-17.

Taylor, B. K. (1969). The Nyoro. In: Taylor, B. K., (ed.) *The Western Lacustrine Bantu*. International African Institute, pp. 17-41.

Tenywa, G. (2005). Monkey Meat Sold in City: UWA warns that bush meat carries ebola virus. *The New Vision,* 27 August 2005. p, 1.

Thornton, J. (1998). Protected Springs. In: Thornton, J., (ed.) *Sourcebook of Alternative Technologies for Freshwater Augmentation in Africa.* Technical Publication Series 8, Osaka: The International Environment Technology Centre of the UNEP.

Tourenq, C., Aulagnier, S., Durieux, L., Lek, S., Mesleard, F., Johnson, A. and Martin, J. (2001). Identifying Rice Fields at Risk from Damage by the Greater Flamingo. *Journal of Applied Ecology* 38, pp. 170-179.

Tumusiime, D. M. (2004). *Willingness of Hunters around Budongo to Undertake Alternative Livelihood Strategies*. Feasibility Study Report for Jane Goodall Institute (Uganda).

Tweheyo, M., Hill, C. M. and Obua, J. (2005). Patterns of crop raiding by primates around Budongo Forest Reserve, Uganda. *Wildlife Biology* 11, pp. 237-247.

UBOS (2005). *2002 Uganda Population and Housing Census*. [Online]. Retrieved on 11 July 2006 from: www.ubos.org

UMOH (2006a). *Diseases Targeted for Eradication*. [Online]. Retrieved on 14 August 2006 from: www.health.go.ug/blood_trans

UMOH (2006b). *Malaria Control Programme (MCP) of Uganda*. [Online]. Retrieved on 30 May 2006 from: www.health.go.ug/mcp/index2

UMOH (2006c). *An Overview of HIV/AIDS in Uganda.* [Online]. Retrieved on 3 September 2006 from: www.health.go.ug/pub_health.htm

USDA (2004). *Number of Animals Killed and Methods Used by the WS Program, FY2004.* [Online]. Retrieved on 28 February from: www.alphis.usda.gov

Van Gelder, J. J. (1973). A Quantitative Approach to the Mortality Resulting from Traffic in a Population of *Bufo bufo* L. *Oecologia* 13, pp. 93-95.

Van Vuren, D. and Smallwood, K. S. (1996). Ecological management of vertebrate pests in agricultural systems. *Biological Agriculture & Horticulture* 13, pp. 39-62.

Vansina, J. (1990). *Paths in the Rainforest. Toward a History of Political Tradition in Equatorial Africa.* Madison: University of Wisconsin Press.

Vercammen, P. A., Seydack, A. H. W. and Oliver, W. L. R. (1993). The Bush Pigs (*Potamochoerus porcus* and *P.larvatus*). In: Oliver, W. L. R., (ed.) *Pigs, Peccaries and Hippos.* Gland, Switzerland: IUCN, pp. 93-101.

Viggers, K. L. and Hearn, J. P. (2005). The Kangaroo Conundrum: home range studies and implications for land management. *Journal of Applied Ecology* 42, pp. 99-107.

Vision, N. (2004). *Why Iguru will sue Britain.* [Online]. Retrieved on 10 January 2004 from: http://allafrica.com/stories/200404140348

Waller, J. C. and Reynolds, V. (2001). Limb Injuries Resulting from Snares and Traps in Chimpanzees (*Pan troglodytes schweinfurthii*) of the Budongo Forest, Uganda. *Primates* 42, pp. 135-139.

Wallis, J. and Lee, D. R. (1999). Primate Conservation: the prevention of disease transmission. *International Journal of Primatology* 20, pp. 803-826.

Walpole, M. J. and Leader-Williams, N. (2002). Tourism and Flagship Species in Conservation. *Biodiversity and Conservation* 11, pp. 543-547.

Warren, Y. (2003). *Olive Baboons (Papio cynocephalus anubis): behaviour, ecology and human conflict in Gashaka Gumti National Park, Nigeria.* PhD Thesis, School of Life and Sports Sciences: University of Surrey Roehampton.

Webber, A. D., Hill, C. M. and Reynolds, V. (In Press). Assessing the Failure of a Community-Based Human-Wildlife Conflict Mitigation Project in Budongo Forest Reserve, Uganda. *Oryx*.

Weladji, R. B. and Tchamba, M. N. (2003). Conflict between people and protected areas within the Benoue Wildlife Conservation Area, North Cameroon. *Oryx* 37, pp. 72-79.

Wheatley, B., Stephenson, R., Kurashina, H. and Marsh-Kautz, K. (2002). A Cultural Primatological Study of *Macaca fascicularis* on Ngeaur Island, Republic of Palau. In: Fuentes, A. and Wolfe, L. D., (ed.) *Primates Face to Face: the conservation implications of human-nonhuman interconnections.* Cambridge: Cambridge University Press, pp. 240-253.

WHO (2003). *Fact Sheet - Influenza.* [Online]. Retrieved on 5 September 2006 from: www.who.int/mediacentre/factsheets/fs211/en/index

WHO (2006). *Health Topics: Malaria.* [Online]. Retrieved on 8 June 2006 from: www.who.int/topics/malaria/en

Wild, R. G. and Mutebi, J. (1997). Bwindi Impenetrable Forest, Uganda: conservation through collaborative management. *Nature & Resources* 33, pp. 33-51.

Williamson, S., Little, A., Ali, M. A., Kiman, M., Meir, C. and Oruko, L. (2003). Aspects of Cotton and Vegetable Farmer's Pest Management Decision-Making in India and Kenya. *International Journal of Pest Management* 49, pp. 187-198.

Wilson, M. A. (1997). The Wolf in Yellowstone: science, symbol or politics? *Society and Natural Resources* 10, pp. 453-468.

Wolfheim, J. H. (1983). *Primates of the World: distribution, abundance and conservation.* Seattle: University of Washington Press.

Woodroffe, R., Thirgood, S. and Rabinowitz, A. (Eds.) (2005) *People and Wildlife: conflict or coexistence?,* Cambridge University Press, Cambridge.

Wrangham, R. W. (1974). Artificial Feeding of Chimpanzees and Baboons in their Natural Habitat. *Animal Behaviour* 22, pp. 83-93.

Yaffee, S. L. and Wondollek, J. L. (2000). Making Collaboration Work: lessons from cases in environmental management. *Conservation Biology in Practice* 1, pp. 17-19 & 22-25.

Yayock, J., Y., Lombin, G. and Owonubi, J. J. (1988). *Crop Science and Production in Warm Climates.* London: Macmillan Publishers Ltd.

Zhao, Q. (2005). Tibetan Macaques, Visitors and Local People at Mt. Emei: problems and countermeasures. In: Paterson, J. D. and Wallis, J., (ed.) *Commensalism and Conflict: the human-primate interface.* Vol. 4 Norman, Oklahoma: The American Society of Primatologists, pp. 376-399.

Zinn, H. C. and Andelt, W. F. (1999). Attitudes of Fort Collins, Colorado, Residents Towards Prairie Dogs. *Wildlife Society Bulletin* 27, pp. 1098-1106.

Zinn, H. C., Manfredo, M. J. and Vaske, J. J. (2000). Social Psychological Bases for Stakeholder Acceptance Capacity. *Human Dimensions of Wildlife* 5, pp. 20-33.

## Appendix 1. Map of Budongo Forest Reserve showing the production zone, buffer zones and nature reserve

## Appendix 2. Breakdown of data collection and fieldwork periods

| | 2004 | | | | 2005 | | | |
|---|---|---|---|---|---|---|---|---|
| | Jan-Mar | Apr-June | July-Sept | Oct-Dec | Jan-Mar | Apr-June | July-Sept | Oct-Dec |
| Growing Seasons* | | | | | | | | |
| Researcher at site | | | | | | | | |
| Measuring/ Mapping fields | | | | | | | | |
| Crop Loss Measurement | | | | | | | | |
| Crop Inventories | | | | | | | | |
| Interviews | | | | | | | | |
| Focus Groups | | | | | | | | |

* Subject to seasonal variation due to changing weather patterns

**Appendix 3 – Information Sheet (originally printed on University headed paper)**

# Farmers and Crop Raiding in Uganda

My name is Amanda Webber and I am a PhD student in the Anthropology Department at Oxford Brookes University in the United Kingdom. I am hoping to do research on farmers and crop raiding in Uganda for my PhD thesis. My supervisors are Dr Kate Hill, who many of you may know as she has also worked here in Masindi District, and Dr Stewart Thompson. I will also be working with two Ugandan Field Assistants.

I would like the community of *Village name* to take part in the research study. Before you decide it is important for you to understand why the research is being done and what it will involve. I will describe the project and if you have any questions please ask me. I will leave this information sheet with the Village Chairman and other members of the Village Council on behalf of the village.

**Purpose of the Study**
The purpose of the study is to examine what farmers think of crop raiding by primates, such as vervets, baboons and chimpanzees. *Village name* has been chosen to take part, as I know that there are some problems at the moment with primates raiding local crops. I would like to understand the costs to the farmer and local community, and your views on how the problem can be lessened. I would also like to speak to farmers who are trying the new live traps to see their thoughts. It is also very important that I speak to other people in the community as crop raiding can affect everybody. It is hoped through discussions we can establish what would be acceptable to *Village name* in dealing with this problem and start to discuss these issues with the local wildlife authority.

This is the main part of the study but I would also like to understand how much crop raiding happens here, which monkeys are responsible, how you protect your crops and whether or not the live traps have helped. The study will continue until October 2005 and I plan to visit Uganda twice in that time: now until June and next year from January until October.

It is up to you to decide whether or not to take part. If you decide to take part you are free to leave at any time, without giving a reason and, if you request, the data you have given will not be used in the study.

**Methods**
I would like to speak to as many adults in *Village name* as possible to find out their opinions on primates and crop raiding. This would be in the form of an informal conversation (with translation if necessary) at a convenient time and would take about 30-40 minutes per person. I would either take notes or record the conversation on a tape IF the person was happy for me to do so. No names would be recorded. In addition, a number of farmers will be asked if they are happy to have their fields monitored once a week to measure how many crops are lost and if there is any pattern to where/ which crops monkeys raid. I would then like to hold a number of village meetings with different groups of the

community to explore the issues further – these would mostly take place next year and be about 1 hour long each. Village meetings would also be held before I left for UK in June to keep you up to date on the project and again before I left Uganda next October to present a summary of the research findings.

**Costs and Benefits**
It is hoped that the project will not take up too much of your time but you may be asked some questions on your feelings about crop raiding and you may be asked to participate in a number of group discussions. The University funds this research but I am not paid and therefore I would not be able to offer any reward for taking part in the study. However, there are a number of benefits for all in *Village name* by taking part in this study; you will be able to give your opinion with regards to the issue of crop raiding and the community can begin communicating with the local Wildlife Authority to try and solve the issue. It will also help our understanding of what farmers/ local communities think – few people have researched this before. Only then can we begin to look at ways of solving the problem.

All information collected will be kept locked up when I am in Uganda and UK, and I will be the only person to have access after the data is collected. In addition, all information that you give will be kept strictly confidential (subject to legal limitations); all names will be removed during analysis and no names will be published in either my thesis or any later publications although the village name will be identified if the village is happy for me to do so. Data will be kept for at least five years after the completion of my PhD and to enable use in future publications or to compare with other research.

A research summary will be given to all communities taking part in the research before I leave Uganda. It is hoped that the results from the research will be published and any papers will be kept at Budongo Forest Project and research summaries will be sent to local wildlife conservation groups or NGOs who are working in this area.

**Contact Details**
I can be contacted at Nyabyeya Forestry College Guest House or Budongo Forest Project. I am hoping to be based in a village next year so I can be more accessible. However, the University address is:

*Department of Anthropology*
*School of Social Science and Law*
*Oxford Brookes University*
*Oxford OX3 OBP*
*United Kingdom*

If you ever need further contact details please let me know. The Chair of the University Research Ethics Committee, Oxford Brookes University, has approved the project, however if you have any concerns you can contact them on the address above

I really hope that you will agree to take part in the study and I look forward to working with you!

Amanda Webber

Appendix 4.

OXFORD BROOKES UNIVERSITY

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5 December 2003

Ms Amanda Webber

Dear Ms Webber

**030035 – Primate Crop Raiding in Uganda: predicting, understanding and mitigating the risk**

Thank you for submitting your application to the University Research Ethics Committee. The Committee reviewed your application at its meeting on December 2nd and agreed to **approve** it.

The Committee also discussed several other points which we would like to raise for your consideration but which are not part of the conditions of approval.

1. The Committee accepted your argument that written consent was not appropriate and that consent would be obtained verbally before audio recording the interviews and focus groups and reaffirmed throughout the study. It was suggested that it might be helpful if you tried to document the various ways in which you established and reaffirmed the consent of your participants at the various community, group and individual levels.

2. The Committee noted that your two field assistants will help with translation when you interview participants and suggested that you might consider involving them more actively in the focus groups as facilitators as well as translators.

I hope you find these comments helpful. If you need any further clarification on any points, please do get in touch with me.

In order to monitor studies approved by the University Research Ethics Committee, we will ask you to provide a (very brief) report on the conduct of the study in a year's time. If the study is completed in less than a year, could you please contact me and I will send you the appropriate guidelines for the report.

Yours sincerely

Mary Boulton

Professor Mary Boulton
Chair, University Research Ethics Committee

Cc Dr Kate Hill

## Appendix 5. Summary Information Sheet 2004 (given to all Village Chairmen in 2005)

Research took place from March til end of July 2004 in Kyempunu, Nyabyeya II, Fundudolo and Nyakafunjo. 140 farms[1] were monitored for crop damage and 93 farmers were interviewed. There was a wide range of ethnic groups within the study areas and 70% of those interviewed were dependent on farming for their main source of income to the household.

- Crop damage by animals is widespread; almost 70% of farms had one or more raids. However, not all farmers suffer the same levels of damage due to the location of the farm and the animals responsible.
- Crop damage happened throughout the research period but peaked when crops were maturing (June). Although farmers need to always be vigilant, they may need to concentrate their guarding efforts at this time.
- Animals that caused the most damage were (in order):
  1. Baboon 2. Bushpig 3. Domestic Goat 4. Duiker/ Bush Buck
  where as local people expected them to be:
  1. Baboon 2. Bushpig 3. Duiker/Bush Buck 4. Monkey

  Domestic goats cause a high level of damage in all villages. Although they usually eat only the leaves of crops, this may have a significant effect upon yield at harvesting. Farmers should try and ensure that domestic goats are kept out of fields.
- Farmers also have a number of other crop pests on their farms which could impact upon yield; insect or termite damage was seen on 70% of farms. In addition, 19% of farms had evidence of hailstone damage from storms in late June.
- Many different crops were damaged by animals but maize and cassava seemed to suffer particularly badly. Maize and cassava were also listed by interviewees as the top most important crops to local people.
- Most interviewees did not think that crop raiding could be solved while local people were prevented from clearing the forest, hunting animals and while animals were producing.
- None of the live traps in the study area were functioning – they had either not been maintained or were not working correctly. Many local people said the traps were useful at first but after a time the baboons stopped entering. A number of chimpanzees were released unharmed.

### Research in 2005

If all the farmers are happy for us to continue the work, we would like to continue collecting crop loss data from March-Nov 2005 so we can include both planting seasons. We would also like to conduct more interviews and groups to address the following:

- Farmers' views of differing crop raiding species especially domestic/ wild
- Why some crops are considered more important than others and whether it is possible to grow them away from the forest edge
- Other issues that farmers have to cope with in addition to crop raiding animals and their views of living next to Budongo Forest Reserve
- Farmers' views of different crop protection methods i.e. live traps, buffer crops. Which methods do farmers think work best and what makes them acceptable to local people?

[1] This number reduced to 129 as relationships between families and boundaries were clarified

**Appendix 6. Breakdown of key features of study farms**

| Village | Farm ID | Size ($m^2$) | Number of Fields | Distance from Forest | Number of Buildings |
|---|---|---|---|---|---|
| Kyempunu | 22 | 1901.8 | 1 | Adjoin | 1 |
| Kyempunu | 21 | 1526.0 | 1 | Adjoin | 0 |
| Kyempunu | 9 | 5591.3 | 1 | Adjoin | 1 |
| Kyempunu | 12 | 4028.2 | 1 | Within 250m | 0 |
| Kyempunu | 4 | 24498.0 | 1 | Adjoin | 8 |
| Kyempunu | 3 | 41021.6 | 1 | Adjoin | 4 |
| Kyempunu | 1 | 9227.5 | 1 | Within 250m | 1 |
| Kyempunu | 17 | 1392.9 | 1 | More than 250m | 0 |
| Kyempunu | 19 | 6475.8 | 2 | Adjoin | 2 |
| Kyempunu | 20 | 1986.8 | 1 | Within 250m | 1 |
| Kyempunu | 23 | 1540.0 | 1 | Within 250m | 0 |
| Kyempunu | 10A | 1502.2 | 1 | Adjoin | 0 |
| Kyempunu | 16 | 986.7 | 1 | Within 250m | 0 |
| Kyempunu | 2 | 1587.5 | 1 | Within 250m | 1 |
| Kyempunu | 18 | 15563.3 | 4 | Within 250m | 4 |
| Kyempunu | 11 | 2086.4 | 1 | Adjoin | 1 |
| Kyempunu | 10B | 1653.8 | 2 | Adjoin | 0 |
| Kyempunu | 13 | 2101.0 | 1 | Within 250m | 0 |
| Nyabyeya II | 44 | 13658.5 | 1 | More than 250m | 0 |
| Nyabyeya II | 59 | 14862.9 | 3 | Adjoin | 10 |
| Nyabyeya II | 47 | 14840.3 | 2 | Adjoin | 6 |
| Nyabyeya II | 12 | 2385.5 | 1 | More than 250m | 7 |
| Nyabyeya II | 17 | 485.0 | 1 | More than 250m | 1 |
| Nyabyeya II | 9 | 11121.3 | 3 | Within 250m | 8 |
| Nyabyeya II | 58 | 1386.6 | 1 | Within 250m | 1 |
| Nyabyeya II | 52 | 36990.2 | 4 | Adjoin | 10 |
| Nyabyeya II | 28 | 13239.1 | 1 | Adjoin | 6 |
| Nyabyeya II | 38 | 5683.5 | 1 | Adjoin | 5 |
| Nyabyeya II | 41 | 4504.4 | 2 | More than 250m | 1 |
| Nyabyeya II | 39 | 5484.9 | 1 | Within 250m | 4 |
| Nyabyeya II | 27 | 19636.7 | 1 | Within 250m | 10 |
| Nyabyeya II | 43 | 1524.6 | 1 | More than 250m | 5 |
| Nyabyeya II | 42 | 4419.6 | 1 | More than 250m | 6 |
| Nyabyeya II | 56 | 5021.3 | 1 | More than 250m | 1 |
| Nyabyeya II | 34 | 8902.5 | 1 | Adjoin | 4 |
| Nyabyeya II | 2 | 5052.3 | 1 | Adjoin | 1 |
| Nyabyeya II | 23 | 2128.5 | 1 | Within 250m | 0 |
| Nyabyeya II | 20 | 1472.7 | 1 | More than 250m | 2 |

| | | | | | |
|---|---|---|---|---|---|
| Nyabyeya II | 46 | 6683.6 | 4 | Within 250m | 0 |
| Nyabyeya II | 24 | 1135.7 | 1 | Within 250m | 0 |
| Nyabyeya II | 25 | 1283.8 | 1 | Within 250m | 0 |
| Nyabyeya II | 26 | 2314.8 | 1 | Within 250m | 0 |
| Nyabyeya II | 55 | 1509.6 | 1 | Within 250m | 0 |
| Nyabyeya II | 57 | 10668.4 | 1 | Within 250m | 0 |
| Fundudolo | 29 | 6757.2 | 2 | Adjoin | 4 |
| Fundudolo | 51 | 3140.7 | 1 | Within 250m | 3 |
| Fundudolo | 50 | 2158.6 | 1 | Within 250m | 1 |
| Fundudolo | 39 | 1059.6 | 1 | Adjoin | 1 |
| Fundudolo | 46 | 5972.6 | 3 | Within 250m | 5 |
| Fundudolo | 42 | 4510.0 | 1 | Within 250m | 4 |
| Fundudolo | 37 | 15590.5 | 3 | Within 250m | 6 |
| Fundudolo | 1 | 9848.7 | 1 | Adjoin | 4 |
| Fundudolo | 2 | 1513.7 | 1 | Adjoin | 0 |
| Fundudolo | 3 | 19814.2 | 2 | Adjoin | 6 |
| Fundudolo | 13 | 8579.0 | 1 | Adjoin | 4 |
| Fundudolo | 52 | 4530.5 | 2 | Within 250m | 2 |
| Fundudolo | 54 | 4700.8 | 2 | Adjoin | 1 |
| Fundudolo | 60 | 9629.6 | 1 | Within 250m | 2 |
| Fundudolo | 53 | 20410.5 | 1 | Adjoin | 12 |
| Fundudolo | 47 | 3781.3 | 1 | More than 250m | 3 |
| Fundudolo | 22A | 4783.5 | 1 | Within 250m | 1 |
| Fundudolo | 19 | 9187.2 | 1 | Within 250m | 0 |
| Fundudolo | 7 | 8155.7 | 1 | Adjoin | 3 |
| Fundudolo | 5 | 1616.4 | 1 | Adjoin | 0 |
| Fundudolo | 58 | 4206.7 | 1 | Within 250m | 2 |
| Fundudolo | 56 | 3499.1 | 2 | Adjoin | 3 |
| Fundudolo | 57 | 22915.9 | 1 | More than 250m | 0 |
| Fundudolo | 48 | 20225.5 | 1 | Adjoin | 0 |
| Fundudolo | 11 | 2761.3 | 1 | Within 250m | 0 |
| Fundudolo | 59 | 734.2 | 1 | Within 250m | 1 |
| Fundudolo | 15 | 8983.3 | 1 | Within 250m | 1 |
| Fundudolo | 33 | 5604.4 | 1 | Within 250m | 0 |
| Fundudolo | 20 | 5174.7 | 1 | Within 250m | 0 |
| Fundudolo | 8 | 720.9 | 1 | Adjoin | 0 |
| Fundudolo | 12A | 616.9 | 1 | Within 250m | 0 |
| Fundudolo | 22B | 1000.3 | 1 | More than 250m | 0 |
| Fundudolo | 28 | 826.9 | 1 | Within 250m | 0 |
| Fundudolo | 30 | 441.8 | 1 | Within 250m | 0 |
| Fundudolo | 31 | 880.4 | 1 | Within 250m | 0 |
| Fundudolo | 35 | 520.7 | 1 | More than 250m | 2 |

| | | | | | |
|---|---|---|---|---|---|
| Fundudolo | 36 | 2609.2 | 3 | Adjoin | 0 |
| Fundudolo | 40 | 595.0 | 1 | Within 250m | 0 |
| Fundudolo | 43 | 83098.5 | 1 | Adjoin | 1 |
| Fundudolo | 45 | 1043.5 | 1 | Within 250m | 0 |
| Fundudolo | 12B | 1239.0 | 1 | Within 250m | 0 |
| Fundudolo | 32 | 4805.3 | 1 | Within 250m | 0 |
| Nyakafunjo | 46 | 16452.7 | 2 | Within 250m | 7 |
| Nyakafunjo | 12 | 9491.5 | 2 | Within 250m | 7 |
| Nyakafunjo | 31 | 3481.1 | 1 | Within 250m | 2 |
| Nyakafunjo | 1 | 4625.2 | 1 | Within 250m | 2 |
| Nyakafunjo | 45 | 1858.7 | 1 | More than 250m | 3 |
| Nyakafunjo | 52 | 8672.7 | 1 | More than 250m | 13 |
| Nyakafunjo | 28 | 16348.0 | 1 | Adjoin | 4 |
| Nyakafunjo | 38 | 7226.1 | 4 | More than 250m | 0 |
| Nyakafunjo | 51 | 908.1 | 1 | More than 250m | 0 |
| Nyakafunjo | 11 | 239.3 | 1 | Within 250m | 2 |
| Nyakafunjo | 47 | 752.2 | 1 | More than 250m | 2 |
| Nyakafunjo | 9 | 3076.2 | 2 | Within 250m | 5 |
| Nyakafunjo | 6 | 1912.1 | 1 | Within 250m | 1 |
| Nyakafunjo | 23 | 4305.6 | 2 | Within 250m | 0 |
| Nyakafunjo | 49 | 1367.2 | 1 | More than 250m | 4 |
| Nyakafunjo | 43 | 6572.5 | 1 | Within 250m | 0 |
| Nyakafunjo | 7 | 2370.2 | 2 | Within 250m | 11 |
| Nyakafunjo | 44C | 3938.5 | 1 | Within 250m | 0 |
| Nyakafunjo | 35 | 4063.8 | 1 | Within 250m | 5 |
| Nyakafunjo | 34 | 2064.6 | 1 | Within 250m | 0 |
| Nyakafunjo | 32 | 8887.3 | 1 | Adjoin | 5 |
| Nyakafunjo | 14 | 7187,5 | 2 | Within 250m | 0 |
| Nyakafunjo | 48 | 5067.5 | 2 | Within 250m | 3 |
| Nyakafunjo | 41 | 17571.2 | 1 | Within 250m | 10 |
| Nyakafunjo | 44 | 1001.8 | 1 | Within 250m | 3 |
| Nyakafunjo | 10 | 1948.6 | 2 | Within 250m | 5 |
| Nyakafunjo | 37 | 11675.6 | 2 | Within 250m | 6 |
| Nyakafunjo | 29 | 5076.5 | 1 | Adjoin | 1 |
| Nyakafunjo | 15 | 1018.4 | 1 | Within 250m | 3 |
| Nyakafunjo | 21 | 279.0 | 1 | Within 250m | 0 |
| Nyakafunjo | 2 | 3237.7 | 1 | Within 250m | 10 |
| Nyakafunjo | 27 | 4948.5 | 1 | Within 250m | 2 |
| Nyakafunjo | 24 | 1662.3 | 1 | Within 250m | 0 |
| Nyakafunjo | 26 | 13510.0 | 1 | Adjoin | 2 |
| Nyakafunjo | 40 | 3001.3 | 1 | Within 250m | 1 |
| Nyakafunjo | 8 | 2966.5 | 1 | Within 250m | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Nyakafunjo | 30 | 4108.7 | 1 | Within 250m | 1 |
| Nyakafunjo | 3 | 3429.9 | 1 | Within 250m | 6 |
| Nyakafunjo | 4 | 770.5 | 1 | Within 250m | 0 |
| Nyakafunjo | 5 | 157.4 | 1 | Within 250m | 1 |
| Nyakafunjo | 16 | 201.9 | 1 | Within 250m | 2 |
| Nyakafunjo | 33 | 1591.9 | 1 | Within 250m | 0 |
| Nyakafunjo | 44B | 600.4 | 1 | Within 250m | 0 |
| ***TOTAL*** | ***129*** | ***838936.9*** | ***169*** | | ***313*** |
| *Mean* | | *6503.4* | *1* | | *2* |
| *Median* | | *3781.3* | *1* | | *1* |

## Appendix 7 – Crop Loss Data Sheet

**Date -** *23 March 2004* **Village –** *Nyabyeya II*

| Farm no | GPS Ref | Crop Damaged | Days since | Stems/ $M^2$ | Plant Part | Plant Maturity | Animal Species | Evidence |
|---|---|---|---|---|---|---|---|---|
| *16* | *01° 31.564/31° 32.778* | *Maize* | *2* | *4* | *Stem* | *Mature* | *Goat* | *Prints, dung* |
| *41* | *01°31.589/31°32.901* | *Sweet Potato* | *0* | *3 heaps* | *Tuber* | *Immature* | *Baboon* | *Researcher seen, prints* |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
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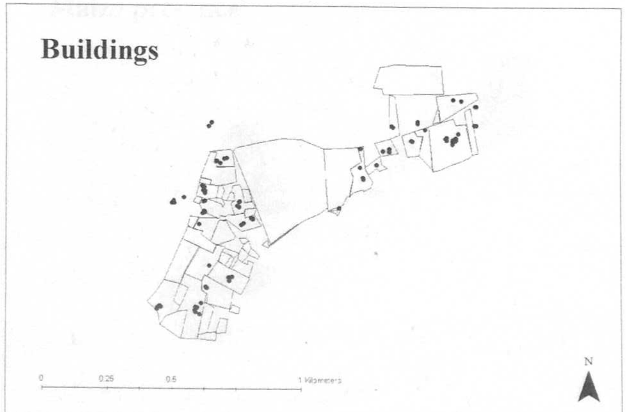
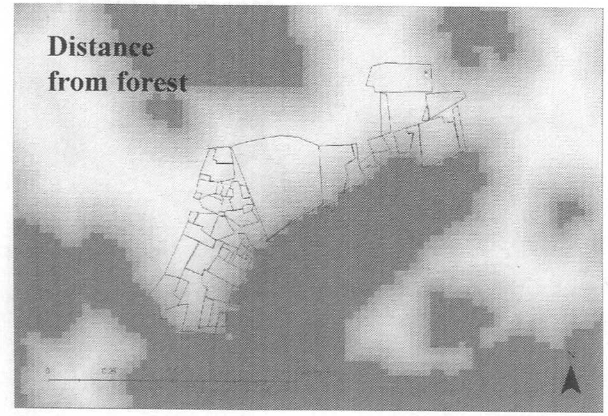
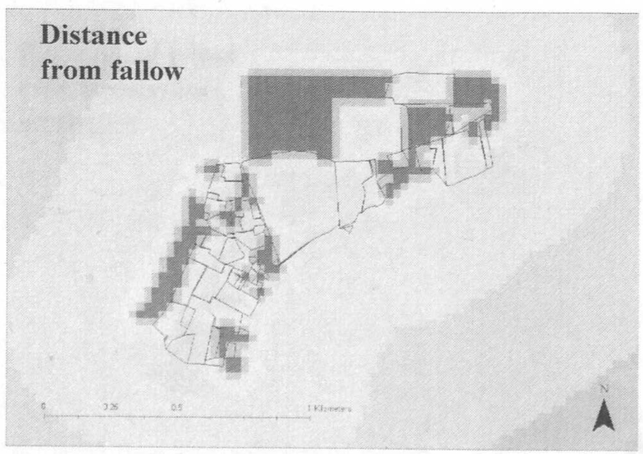
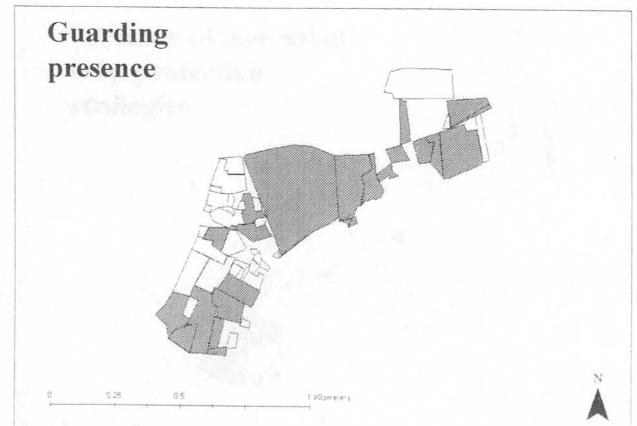
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

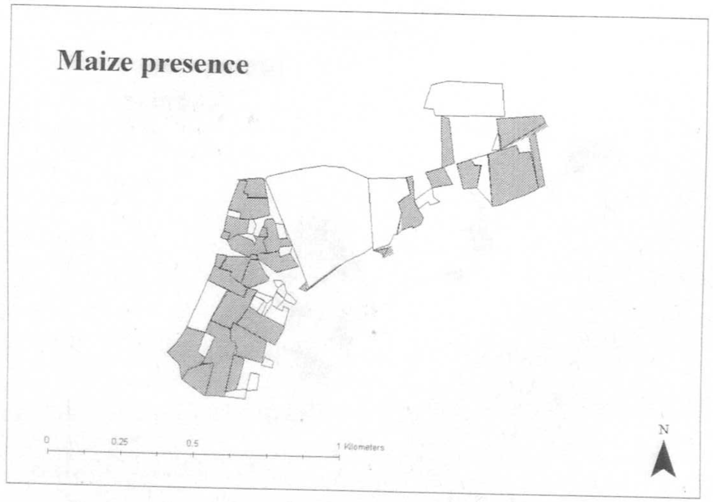
## Appendix 8. Examples of the variables used in creating probability maps of risk (greyscale in the distance maps indicate closeness and in presence maps indicate presence of variable)

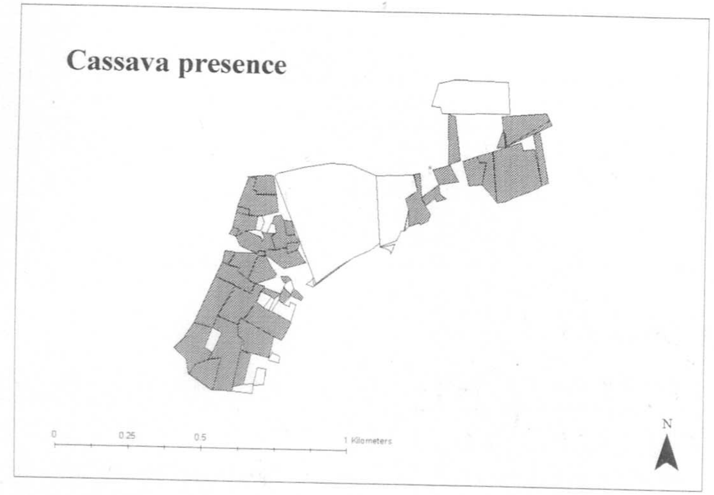


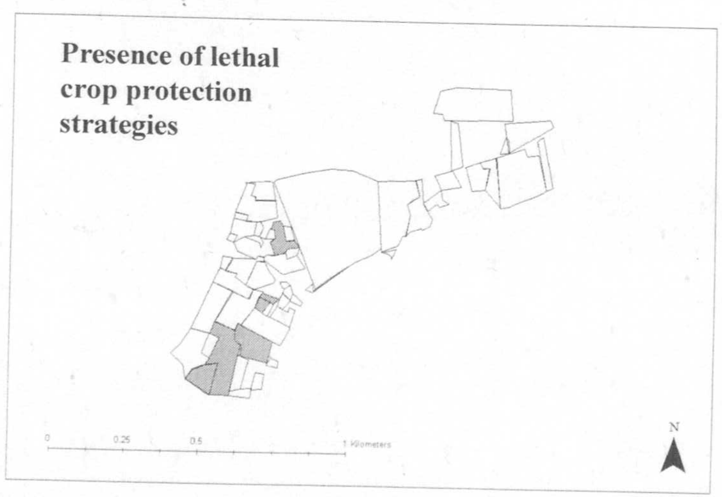



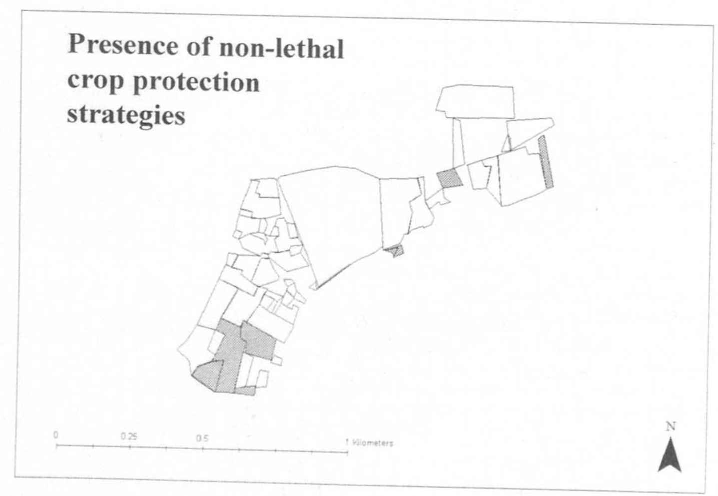



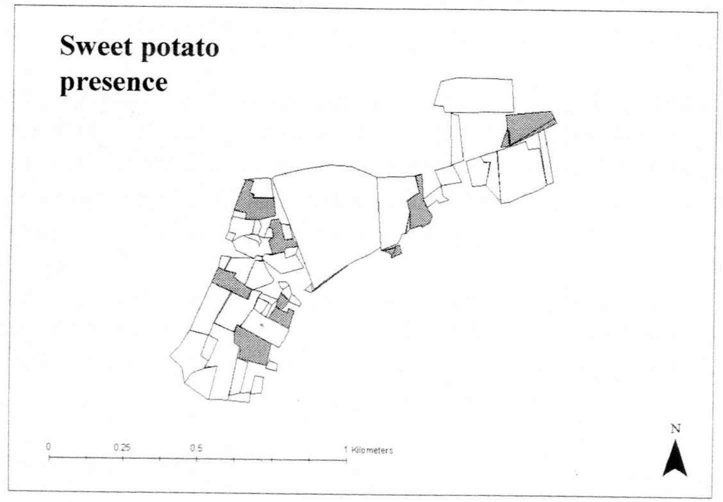




Maize presence
0
0.25
0.5
1 Kilometers
N


Cassava presence
0
0.25
0.5
1 Kilometers
N


Presence of lethal
crop protection
strategies
0
0.25
0.5
1 Kilometers
N


Presence of non-lethal
crop protection
strategies
0
0.25
0.5
1 Kilometers
N


Sweet potato
presence
0
0.25
0.5
1 Kilometers
N

## Appendix 9 – Semi Structured Interview Guide (Season 1)

My name is Amanda Webber and I am a PhD student at Oxford Brookes University in the UK. I am hoping to do research on farmers and crop raiding in Uganda for my PhD. Hopefully you will have seen the information sheet given to the village, if not would you like me to read it to you?

I would like to ask some questions on your feelings about crop raiding, it is important that we understand what farmers think as few people have researched this before and only then can we begin to look at ways of solving the problem. The University funds this research but I am not paid so I am not able to offer any reward for taking part in the interview. It should only take 30 minutes of your time but it is up to you to decide whether or not to take part. If you decide to take part you are free to leave at any time, without giving a reason and if you request, the data you have given will not be used in the study. Would you like me to continue?

All information collected will be kept locked up when I am in Uganda and UK, and I will be the only person to have access after the data is collected. In addition, all information that you give will be kept strictly confidential and your name will not be taken although the village name will be identified. Data will be kept for at least five years after I finish my PhD, to enable use in future publications or to compare with other research.

**Are you happy for me to take notes?**

VILLAGE ______________________

**Gender -** Male ☐ Female☐ **Age -** 16-25 ☐ 26-35 ☐ 36-45 ☐ over 45 ☐

**Ethnic Group –** ______________ **Education -** None ☐ Primary ☐ Secondary ☐ University ☐

**Ownership** – Livestock ____________ Bicycle ☐ Radio ☐

**Occupation of main earner –** ______________ **Number of people living in house** ______________

**How long have family lived in village -** __________ **Where living before** ______________

| *Question* | *Prompts* | *Notes* |
|---|---|---|
| **1. What are you doing on your farm at the moment?** | Please describe for me a usual day<br>What crops are being planted?<br>Is it the same throughout the year?<br>Who works on the farm? | |
| **2. Which crops are most important to you?** | Why? | |
| **3. Have you experienced any problems with your crops? If so, what were they?** | Poor soil, disease, pests, weather?<br>Has this always been a problem?<br>What was it like in the past? | |
| **4. Have you ever seen animals in your or your neighbour's farm? If so, what were they?** | Species, domestic or wild? NAME<br>Are there any particularly troublesome animals? NAME<br>Where?<br>How often do you see them? | |
| **5. How do you protect your crops from wildlife?** | Plant specific crops as buffer | |
| **6. How do you think the situation could be solved? Is there anything else you would like to tell me** | | |

Thank you so much for your time, your answers have been really useful and valuable to the study. I will be interviewing many other people in the community to get as many thoughts on crop raiding as possible. I will be leaving for UK in June but hope to hold a village meeting in ____________ to summarise what I found out at the interviews. I will be coming back to Uganda in January next year for a longer stay to do some more research in this area.

Thanks again for all your help, it is much appreciated.

**Appendix 9 cont. – Semi Structured Interview Guide (Season 3)**

| *Question* | *Prompts* | *Notes* |
|---|---|---|
| **1. Have you ever grown cash crops (Sugar cane/ tobacco?** | If yes, why have you stopped?<br>If no, why not? | |
| **2. Is this land owned by you or leased?** | How did you get? Who did you buy it from? | |
| **Have you seen any changes in the following since you have been here:**<br>*Land Availability*<br>*Soil Quality*<br>*Tree Cover*<br>*Water*<br>*Firewood*<br>*Sickness*<br>*Education*<br>*Employment*<br>*Wild Animals*<br>*Crop Disease and Insects* | Has it increased, decreased or is it the same as when you arrived? | |
| **3. I can see you have planted _____ close to the forest edge, why is it not planted further from animals?** | Why isn't it planted closer to the house? | |
| **4. Can you give me one word to describe the following animals:**<br>*Monkey*<br>*Goat*<br>*Baboon*<br>*Amur*<br>*Chimpanzee*<br>*Bush Pig* | What do you think about ____? Is it a negative or positive animal? Can you summarise what you think about it in one word? | |

| | | |
|---|---|---|
| **5. Would you agree that there are 3 main ways to stop animals raiding:**<br><br>**A: Stop them coming into farm – fence/ buffer crop**<br>**B: Get them out once in – chase/ make loud sounds/ scarecrows**<br>**C: Kill them – trap/ poison**<br><br>**If you could do anything, which would you be willing to use for each animal:**<br>*Monkey*<br>*Goat*<br>*Baboon*<br>*Amur*<br>*Chimpanzee*<br>*Bush Pig* | Make sure they agree first and ask for further ideas from them<br><br>I do not mean what you are doing now but what you would do if you were able to do anything. | |
| **6. Who is responsible for protecting crops against wild animals?** | | |
| **7. What are the benefits to having a) the forest, b) its wildlife here?** | | |
| **8. If someone came and said they had a way of helping to protect crops, what would make you try it?** | | |
| **9. Would you be willing for another researcher to visit you in the future? Is there anything else you would like to tell us?** | | |

**Appendix 10. Focus Group Questions**

**1) If you were able to change something about where you were living what would it be?** *[Group were asked to choose a symbol to represent this; they either selected something from around the compound (i.e. stone), drew it on the ground or asked the facilitator to draw it on a card. The facilitator then added the responses collected in the semi structured interviews. From this complete list, the group was asked to rank their top 3 most important issues. Each person was given 6 beans and asked to place3 next to the most important, 2 for the next and 1 for the next].*

**2) How does crop damage affect you/ your household/ your village?**

*3)[A time line drawn on the floor – January and December are marked at either end and the seasons are indicated along it.]* **When on this time line does the most crop damage occur? When are you most busy in the farm? When did/do you traditionally hunt?**

*4) [A sketch map of the study area drawn on the ground, indicating farms belonging to group members]* **Please draw on the map where most crop damage occurs.**

*5) [Group shown picture cards of the top six most troublesome species from Study Season 1)].* **Please place cards in order of the animal that causes most damage. Please give a word that best represents each animal.**

**6) Have you heard of any good ways to protect your crops from damage? Are you trying this? If not, why not?**

**7) Who owns the forest?**

**8) Is there anything else you would like to discuss?**