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Attitudes of Rural Communities Toward Wetlands and Forest Fragments Around Kibale National Park, Uganda

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Rapid population growth, high population density, and intensive agriculture characterize the landscape surrounding Kibale National Park in western Uganda. Forest fragments and wetlands scattered throughout the agricultural landscape provide important natural resources for local people. These forest fragments, however, also provide habitat for animals that raid crops and threaten local agricultural practices, leading to human–wildlife conflict in the buffer zone of the park. Using a geographically stratified, random sampling technique to select study sites, 130 households outside Kibale were interviewed to understand human–agriculture–wildlife conflicts and how these problems vary spatially and demographically. Primates were the most common taxa associated with crop raiding, with vervet and redtail monkeys ranked as the worst crop raiders overall. Baboons and elephants were also problematic in agricultural areas proximate to the park boundary. Despite the problems reported, most respondents prefer to live closer to forest fragments and wetlands because of greater access to natural resources.

Keywords protected area, livelihoods, crop raiding, forest fragments, wetlands, kibale national park

Introduction

Parks and protected areas are designated as areas of biological, geological, or cultural significance and serve as key mechanisms for conservation (Struhsaker, Struhsaker, & Siex, 2005). The park literature has focused on the history of expulsions and exclusions that were central to park establishment and continue to affect local people's perceptions about protected areas (Brockington & Igoe, 2006; Neumann, 1998; Schmidt-Soltau & Brockington, 2007; Shetler, 2007). Although conservationists often view parks as fundamental to maintaining productive capacities of ecosystems and protecting species diversity (Terborgh & van Schaik, 2002), studies of protected areas in Sub-Saharan Africa have examined the inherent conflicts between local villages and the conservation of plant and

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animal diversity (Kaswamila, Russell, & McGibbon, 2007; Mkanda & Munthali, 1994; Naughton-Treves, 1997).

In the Africa context, protected areas that preserve tropical forests often occupy and/or are surrounded by land that is highly suitable for agriculture and thus can support large populations (Goldman, Hartter, Southworth, & Binford, 2008). Some protected areas benefit from well maintained, hard boundaries that exclude the local population from access and extractive privileges (e.g., Brockington, 2002; Neumann, 1998). Growing populations are forced to rely on land and resources outside park boundaries, particularly forest fragments and wetland areas. Forest fragments and wetlands provide numerous social and ecological services and while the park may remain intact, unprotected fragments, have become increasingly used, degraded, and converted to other land uses (Chapman, Chapman, & Chandler, 1996; Marsh et al., 2003).

In densely settled park landscapes with growing populations, landscape fragmentation resulting from agricultural expansion leads to conflicts between local villagers and the biodiversity that the park seeks to protect. Intensified use of forest fragments and wetlands has caused a substantial decline in habitat for wildlife (Chapman, Balirwa, Bugenyi, Chapman & Crisman, 2001). As natural habitat becomes increasingly scarce, wildlife that once freely travelled from the park to the forest fragments and wetlands outside the park must now cross the agricultural mosaic. Other animals capable of residing in forest fragments become isolated and must rely on agricultural lands to supplement dietary needs that would otherwise be found in larger forested fragments. All of this results in increased incidences and severity of crop raiding by wildlife (Naughton-Treves, 1997; Onderdonk & Chapman, 2000).

Households, particularly those near park and forest edges, are often adversely affected by crop raids—crop loss, human injuries, human sickness, and even human fatalities all caused by wildlife (Hill, 1997, 2004; Kaswamila et al., 2007; Naughton-Treves, 1997; 1998; de Boer & Baquete, 1998; Gillespie & Chapman, 2006). Naughton-Treves (1998) argued that proximity to the park boundary was the strongest predictor for crop raiding events and damage, and that the frequency of damage events to crops decreased further from the park boundary (maximum 500 m). This and other studies reviewed by Brown-Nuñez and Jonker (2008), however, used a limited number of locales focused within a narrow band along the park boundary. These results are biased toward those communities proximate the park boundary and suffer from two potentially significant errors. Such studies may overstate human–wildlife conflicts that only a small proportion of the population is having or may underreport certain wildlife that may be more deleterious to a larger range of people. The limited geographic scope of these studies may also fail to capture the broader social narrative across the aggregated landscape.

What is missing is an empirical study that focuses more broadly on the issues households face in the domesticated landscape outside the park. To provide a more representative snapshot of livelihoods in a park landscape, research must consider communities at various distances from the park boundary and at multiple locales not just those next to the boundary (Kaltenborn, Bjerke, & Nyahongo, 2006). To develop proper conservation approaches and wildlife intervention programs in park landscapes, trends in the aggregate landscape, not just those in communities neighboring the park boundary, must be considered. By examining attitudes of locals, decision-makers can move toward a better understanding of potential influences of behavior and effectiveness of conservation measures (Browne-Nuñez & Jonker, 2008), particularly in areas of high human–wildlife conflict in the context of dwindling resources (Manfredo & Dayer, 2004) where generally poor local residents face losses and hazards posed by wild animals (Naughton-Treves, 1997). Ethnicity, wealth, and gender, not simply distance from the park, can be important predictors in determining attitudes associated with protected areas (Fiallo & Jacobson, 1995; Gillingham & Lee, 1999), which in

turn can influence behavior (Browne-Nuñez & Jonker, 2008) (e.g., mechanisms for problem wildlife mitigation (Ogra & Badola, 2008)), land use and management (DiStefano, 2005), and ultimately shape the park landscape.

Kibale National Park (Kibale) in western Uganda is emblematic of social pressures facing forest parks in the Albertine Rift and elsewhere in Sub-Saharan Africa. Outside the park, unprotected forest fragments and wetlands have reduced in size, number, and have become more isolated. Remaining fragments serve as a buffer to Kibale by providing resources to people that would otherwise be extracted from the park. These fragments, however, are also problematic because of crop raids by wild animals that emanate from them and reduced access to resources. To better understand problems associated with fragments, two research questions were posed. First, since the establishment of Kibale National Park and the exclusion of local residents from access and resource extraction, what problems do households associate with wetlands and forest fragments around Kibale National Park? Second, how do these problems vary according to location (distance from the park, forest fragment, and wetland), by nearest forest fragment and wetland size, and demographic (gender, wealth, and ethnicity)?

Study Region

Uganda has 4.9 million ha of forests and 3.1 million ha of wetland, representing 4.8% and 7.8% of Uganda's total area, respectively; the majority of which remain unprotected and vulnerable to encroachment (National Environment Management Authority, 2001). Wetlands (which are dominated by papyrus, *Cyperus papyrus* L.) and forests support human livelihoods by providing fuel wood, building poles, timber, charcoal, medicines, water, craft materials, and supplemental food (Banana & Gombya-Ssembajjwe, 1998; MacLean, Tinch, Hassall & Boar, 2003). Each year, however, Uganda loses 50,000 ha of its forest and 565,000 ha of original wetlands have been drained and converted to other land uses (NEMA, 2001), such as agriculture, woodlots, pasture, or for commercial use of papyrus (Crisman, Chapman, Chapman, & Kaufman, 2003).

Kibale National Park (795km^2) (Figure 1) in western Uganda, a remnant of a previously larger mid-altitude forest region, was elevated from a forest reserve to a national park in 1993 (Struhsaker, 1997). Elevations in and around the park range from about 1,100 to 1,600 m. The amount of rainfall and length of the rainy season vary by altitude and aspect, but the average annual rainfall for the region is about 1,540 mm for the period 1903–1999, increasing to about 1,720 mm in the period 1990–2005 (Chapman, unpublished data).

Population around Kibale grew by more than 300% between 1959 and 1990 (Naughton-Treves, 1998) and the area is one of the most densely populated areas in Sub-Saharan Africa (Lepp & Holland, 2006). In 2006, the population was estimated at 262 individuals/km^2 (west side) and 335 individuals/km^2 (east side) within 5 km of the park boundary (Hartter, 2007). Farmers primarily belong to two ethnic groups. Batoro is the dominant ethnic group in the area west of the park. They settled in the area around Kibale during the first half of the 20th century. The immigrant Bakiga, who have been coming to the region from Kabale in southwestern Uganda since the 1950s because of land scarcity (Naughton-Treves, 1998), are the dominant ethnic group on the east side of the park. The in-migration of the Bakiga and other ethnic groups (e.g., Banyoro, Banyankole) has greatly increased the local demand for agricultural land and resources (e.g., fuel wood, food, medicines, building poles). Both dominant ethnic groups plant a mixture of subsistence and cash crops, with bananas, maize, beans, and cassava as the main staple foods.

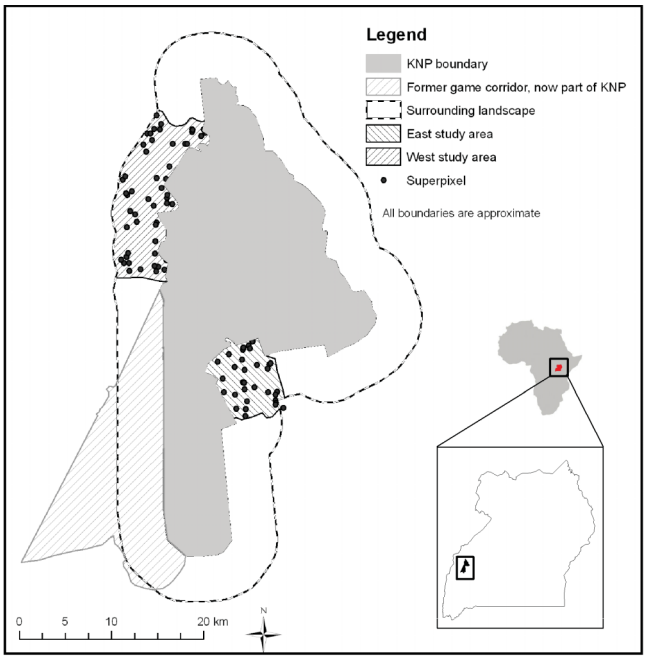

Figure 1. Kibale National Park and the east and west study areas. The landscape is a mosaic of intensively farmed small landholdings (most <5 ha in size), large tea estates, and interspersed forest fragments (<0.5 ha to 210 ha) and wetlands (<0.5 ha to 420 ha). Within these areas, 39% is covered by crops and pasture grass, 11% by tea, 27% by forest, and 22% by wetland (Hartter, 2007).

Methods

To examine a broader geographic region that was still linked to the park, a five kilometer perimeter around park boundaries was defined as the general research area. Two mid-scale research areas were identified for social science research on the east and west sides of the park (comprising approximately 110 km^2 on the west and 56 km^2 on the east). The two regions differ to some extent in altitude, ethnic composition, and settlement and land use history. Geographic coordinates were selected at random within the two research areas. These became the centers of 9-ha sampling units (circles with radii 170 m) termed "super-pixels" (based on a much larger version of the typical 30 m grid cell popularly called a "pixel" and used as the unit of analysis in land use/cover change analyses) (Hartter and Southworth, 2009; Goldman et al., 2008). Interview respondents were selected from among landholders in each of the 68 superpixels (36 on the west and 32 on the east sides of the park) for which there were landholders (Figure 1).

Between May and August 2006, 130 semi-structured household interviews were conducted. The number of respondents selected per superpixel was proportional to the number of landholders controlling land within the study area. At least one interview was conducted in each superpixel. Superpixels with more landholders (and correspondingly smaller individual landholdings) had a higher sampling intensity than those with fewer landholders. Since each superpixel comprised only 9 ha, there was only a small potential sample pool of households connected with each one. Houses were selected based on proximity to the center of the superpixel. The closest house was selected for the first interview, the next closest

for the second interview. To establish trust and credibility within the communities, affiliated researchers have been working in these communities since 2004; a pilot study was conducted May–August 2005, permissions were obtained from local government officials and village chairmen (LC1), and a local field assistant was hired. The survey was pre-tested to assess clarity, perception of researchers, and training of field assistants (Kaswamila et al., 2007). Interviews were conducted in person using a trained interpreter in one of the main local languages, Rutoro or Rukiga, or in English. Respondents were not paid, but were provided a token gift. Although the researcher had worked in the area for 2 years, the researcher and his team were still likely perceived as an "outsider," which inevitably affected data to some extent.

Respondents were asked general questions about household composition, employment, and land use, and then were asked whether or not they had problems with wildlife. If they had problems, respondents were asked to identify the problem animals and to describe the problems. Respondents who identified "monkey" as a problem were shown pictures of primates endemic to the region to identify the species, since the local languages use *enkende* as a general term for "monkey" and most people do not know species names.

A dendogram produced from agglomerative cluster analysis (Ward's method) using wealth indicators from each respondent (number of animals (goats and cows) per household, head of household gender, total amount of land held, house category (based on a 5-category classification of house construction materials)) was used to cluster respondents into three classes ("below average," "average," and "above average") (Aldenderfer & Blashfield, 1984). A k-means cluster analysis was used to segment the nearest wetland and forest fragment for each respondent's house into two size categories (0–5ac[1] and >5ac) because sizes could only be estimated in the field due to limited access and permission. Relationships between responses and predictors were examined using logistic regression. Non-significant terms were dropped one at a time to achieve a more parsimonious reduced model.

Results

Most respondents (74%, $n = 130$) reported problems with wild animals raiding crops and killing small livestock (e.g., goats, chickens) (Table 1). All respondent-identified problems were perceived as current or immediate threats that have tangible effects on their livelihoods, not hypothetical or past problems. The redtail (*Cercopithecus ascanius*) (65%) and vervet monkeys (*Cercopithecus aethiops*) (51%) were cited as the most common nuisance animal (Table 2). Bakiga farmers tended to report problems with L'Hoesti monkeys (*Cercopithecus lhoesti*) ($p = .005$); redtail monkeys ($p = .006$), mongoose (unknown sp.) ($p < .001$), and serval cats (*Felis serval*) ($p < .001$) more often than Batoro farmers. Batoro farmers were more likely to report problems with elephants ($p = .017$). More male respondents reported problems with baboons ($p = .024$) and black and white colobus (*Colobus guereza*) ($p = .037$) than female respondents.

Distance appears to be related to particular problem animals. Baboons ($p < .001$), elephants ($p < .001$), and bush pig (*Potomochoerus porcus*) ($p = .011$) were reported at farms closer to the park boundary, while households farther from the Kibale boundary reported vervet monkeys ($p < .001$) and mongooses ($p = .010$). Distance to forest fragments and wetlands was not significantly related to crop-raiding primates ($p > .05$), but was for mongooses (forest fragments) ($p = .008$), bushpigs (forest fragments) ($p= .007$), and elephants (wetlands) ($p = .016$). Households closer to the fragments tended to report problems with bushpigs (forest fragments) and elephants (wetlands), while those households farther from the forest fragments tended to report problems with mongoose more frequently. Households near bigger fragments tended to report problems of red colobus (wetlands)

Table 1
Logistic regression of problems with wildlife associated with nearby forest and wetlands on ethnicity, respondent gender, wealth, size and distance to fragment, and distance to Kibale (Results reported at significance levels $\alpha = 0.1$ and 0.05). Of the 130 respondents, 96 (74%) reported problems with wildlife.

			p-value (odds ratio)	
Predictor	*n*	%	Full model	Reduced model
Ethnicity				
Batoro	72	71	n.s.	n.s.
Bakiga	46	80		
Other	12	67		
Respondent gender				
Male	63	78	n.s.	n.s.
Female	67	70		
Wealth class[b]				
Below average	58	78	n.s.	n.s.
Average	59	69		
Above average	13	77		
Size of forest fragment[a,b]				
0–5ac	76	74	n.s.	n.s.
>5ac	43[c]	82		
Size of wetland[b]				
0–5ac	89	70	n.s.	.063 (2.510)
>5ac	41	82		
Log distance to park	130		n.s.	n.s.
Log distance to forest fragment	123		n.s.	n.s.
Log distance to wetland	130		n.s.	.036 (0.160)

[a]Only 123 people had forests fragments within 2 km of their home.
[b]Although this is a categorical, it was treated as a continuous variable in the logistic regression.

($p = .037$), while those near larger fragments tended to report vervet monkeys (forest fragments) ($p = .003$) and bushpigs (forest fragments) ($p = .004$) as problematic. Elephants were reported as problem animals by households up to 3 km from the park boundary (mean 588 m); while baboons were reported by households up to 2 km from the park boundary (mean 814 m) (data from Global Positioning System (GPS) coordinates of farms reporting raids within last year). Small monkeys and baboons traveled well beyond the boundaries of the fragments to raid farmers fields (raids were reported by farms located more than 500 m to the closest fragment), but mean distance of raided farms to the closest fragment was farther for baboons (340 m) than small monkeys (298 m). Elephants tended to stay relatively close to fragments and raid farms less than 300 m from the edges (mean 230 m).

While many respondents reported problems with animals in general, they differed in their perception of the worst overall pest. Of those that reported problems with wildlife (96 of 130 respondents), 51% of respondents stated that small monkeys (vervet, redtail, black and white colobus, red colobus, L'Hoesti) not only were problem animals, but were the greatest problem animal overall, with vervet and redtail monkeys as the top perpetrators (Table 3). Small monkeys were perceived as the greatest problem in households located

Table 2a

Logistic regression of problem animals reported by households (n = 130) on ethnicity, respondent gender, wealth, size and distance to fragment, and distance to Kibale (Results reported at significance levels α = 0.1 and 0.05).

	Olive baboon (*Papio anubis*)		L'Hoesti monkey (*Cercopithecus lhoesti*)		Redtail monkey (*Cercopithecus ascanius*)		Vervet monkey (*Cercopithecus aethiops*)		Red colobus (*Piliocolobus tephrosceles*)	
% of respondents	35		10		65		51		19	
	p-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)	
Predictor	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model
Ethnicity										
Batoro	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Bakiga	n.s.	n.s.	n.s.	.005 (0.050)	n.s.	.006 (0.297)	n.s.	n.s.	n.s.	n.s.
Respondent gender	.029 (0.304)	.024 (0.365)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	.053 (0.335)
Wealth class	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Size of forest fragment[a]	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	.017 (0.217)	.003 (0.252)		n.s.
Size of wetland	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.037 (2.620)
Log distance to park	<.001 (0.043)	<.001 (0.064)	.067 (0.021)	n.s.	n.s.	.057 (0.188)	<.001 (28.011)	<.001 (10.755)	.027 (0.107)	.051 (0.387)
Log distance to forest fragment	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Log distance to wetland	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Respondents could identify more than one problem animal.

Table 2b

Logistic regression of problem animals reported by households on ethnicity, respondent gender, wealth, size and distance to fragment, and distance to Kibale (Results reported at significance levels α = 0.1 and 0.05).

	Black and white colobus (*Colobus guereza*)		African elephant (*Loxodonta africana*)		Mongoose (unknown sp.)		Serval cat (*Felis serval*)		Bush pig (*Potomochoerus porcus*)	
% of respondents	25		32		39		24		8	
	p-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)		*p*-value (odds ratio)	
Predictor	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model
Ethnicity										
Batoro	n.s.	n.s.	n.s.	.017 (0.208)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Bakiga	n.s.	n.s.	n.s.		n.s.	<.001 (0.217)	n.s.	<.001 (0.231)	n.s.	n.s.
Respondent gender	.018 (0.242)	.037 (0.388)		.042 (0.295)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Wealth class	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Size of forest fragment[a]	n.s.	n.s.	n.s.	n.s.	.051 (3.185)	n.s.	n.s.	n.s.	.021 (0.001)	.004 (0.009)
Size of wetland	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Log distance to park	n.s.	n.s.	.002 (0.000)	<.001 (0.003)	<.001 (9.625)	.010 (4.850)	n.s.	n.s.	.052 (0.000)	.015 (0.000)
Log distance to forest fragment	n.s.	n.s.	n.s.	n.s.	n.s.	.008(3.416)	n.s.	n.s.	n.s.	.007 (0.000)
Log distance to wetland	n.s.	n.s.	.007 (0.001)	.016(0.060)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 3
Logistic regression of the worst problem animals reported by households who reported problems with wildlife (n = 96) on household location (Results reported at significance levels α = 0.1 and 0.05).

	African elephant (*Loxodonta africana*)		Olive baboon (*Papio anubis*)		Small monkeys (including vervet, redtail, red colobus)		Redtail monkey (*Cercopithecus ascanius*)		Vervet monkey (*Cercopithecus aethiops*)	
	n = 17 p-value (odds ratio)		n = 16 p-value (odds ratio)		n = 49 p-value(oddsratio)		n = 21 p-value (odds ratio)		n = 27 p-value (odds ratio)	
Predictor	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model	Full model	Reduced model
Log distance to park	.030 (0.000)	.012 (0.000)	.005 (0.003)	.006 (0.006)	<.001 (100.976)	<.001 (46.541)	n.s.	n.s.	<.001 (870.799)	<.001 (389.616)
Log distance to forest fragment	n.s.	n.s.	.064 (678.114)	.091 (55.663)	n.s.	.097 (0.028)	n.s.	n.s.	.011 (0.000)	n.s.
Log distance to wetland	n.s.	0.056 (0.004)	n.s.	n.s.	.095 (25.119)	.087 (25.698)	n.s.	n.s.	.009 (256.124)	n.s.

farther from the park ($p < .001$). Conversely, households closer to the park boundary reported elephants and baboons as main problems more than those located farther from the park boundary ($p = .012$ and .006, respectively). Although small monkeys were reported as the main crop-raiding problem at farther distances from the park boundary (mean distance from boundary, 2706 m, $p < .001$), farmers throughout the domesticated landscape reported problems with these monkeys.

Discussion

Earlier studies of crop-raiding impacts from Kibale concluded that distance from the park boundary and fragments was strongly related to farm vulnerability and crop raiding and that farms located closer to the park boundary would be more susceptible to raids (Chiyo, 2000; Hill, 1997; Naughton-Treves, 1998). Results from this study reveal the importance of examining the impacts of crop raiding in villages other than those close to the park boundary. Frontline villages are raided often and tend to be raided more heavily by elephants and baboons, but elephants travel much further from the park boundary for some forays. Elephants, coming from the park, travel through the fragments and tend not to stray far from their edges. They typically arrive at night and can appear unpredictably throughout the year, but typically from January to May along the western and northern borders and then shifting to the eastern and southern borders from June to December (Chiyo et al., 2005). Results from this survey suggest that elephants utilize forest patches to travel upward of 300 m away from the park boundary, a distance slightly larger than suggested in previous studies (Hill, 1997; Thouless, 1994).

Fragments that remain connected to the park also enable primates to raid farms farther from the park boundary. Baboons, which reside in Kibale, may temporarily spend a few days within fragments and travel through the fragments to raid fields farther away from the park boundary, but will not reside in them permanently (C. Chapman, personal communication). Red colobus monkeys are sensitive to habitat degradation (Chapman, Naughton-Treves, Lawes, Wasserman, & Gillespie, 2007; Struhsaker, 2005) and the dietary preferences of red colobus may prevent them from living far from the contiguous forest of the national park. They tend not to reach the more outlying farms.

Farther from the park boundary, the dynamic of human–agriculture–wildlife conflicts change. Forest fragments farther from the park and isolated within the agricultural matrix, can support small populations of vervet and redtail monkeys in these disturbed environments (Onderdonk & Chapman, 2000). These small forest fragments adjacent to agricultural lands allow monkeys to remain close to a steady food supply that is essential because of their small size and high metabolic rate (Milton & May, 1976; Struhsaker, 1980). The smaller and more degraded and isolated fragments become, monkey densities increase and the more frequent the crop raid events become. Farmers report the presence of small monkeys (redtail and vervet) in their fields almost daily, especially during the two harvests in January and mid- to late-July through August. However, they perceive the almost constant threat of crop damage by these small primates to be much less severe than the damaging raids by larger primates and elephants that may occur only once or twice in a season.

Results from this study suggest that conflicts with wildlife are uniform across all demographics tested (ethnicity, wealth, gender) in the Kibale landscape. Although ethnicity is related to particular species (serval cat, L'Hoesti monkey), this difference is more a product of preferred habitat and home range than can be attributed to particular land use strategies or other ethnic differences. Chiyo (2000) notes the prevalence of elephant raids common to the western edge of the park, while L'Hoesti monkeys have not been seen for decades on the west side, but commonly raid farms on the east side of Kibale (Chapman, personal communication).

Although results suggest that distance from Kibale and the fragments is a key determinant in vulnerability to crop raids by wildlife, it is not the only means to reduce the number and mitigate the impacts of raids. Farmers often reported the best defense against crop raiding is to have their farm buffered by at least another farmer closer to the forest or wetland (Naughton-Treves, 1998). Many respondents also believe that crop raiding vulnerability is directly related to the proximity to fragments and some cut forests as a pre-emptive attempt to clear their habitat; thereby reducing the frequency of crop raiding events (results taken from informal surveys). "If we cut down all the trees and cut the papyrus in the swamps, where will they [potential crop raiders] live? They will be forced to go back to the park," said one respondent. Respondents expressed a common belief: by cutting and destroying fragments, they can better access resources (from harvested products), food for their families (from crops cultivated in converted forest land), and ultimately safeguard their crops by increasing the distance away from the threat and decreasing wildlife habitat. Cutting, converting, and/or not re-growing forests and draining wetlands as a way to relieve the pressures of wildlife raids is certainly disconcerting to conservationists who value these forest fragments as biodiversity habitat, a stop-gap for park encroachment, and as a buffer to the park. Current pre-emptive cutting may alleviate immediate local concern but protracted assaults may cause even greater ultimate deprivation of food and habit to wildlife and resources to people.

Challenges to Conservation

In the Kibale landscape, the local people are well aware of the conflict that they and their neighbors have with wildlife as a result of living near the park and fragments, but tend to place a higher value on ecosystem services and access to resources. One respondent rationalized their use of forest, "we can do something about the wild animals … we can guard … but we cannot do anything about not getting firewood, poles, and other things. … It is best to be close to those things and have them available." Another explained, "If we [his household] don't use this forest close to us, then someone else will. … It will always be used until it is gone." With so doing (e.g., cutting trees, collecting fuelwood, draining wetlands to plant crops), they not only may create more risk and potential human–wildlife conflict, but also an internal conflict within the community is created. In a time of scarcity, the local elites may tighten control of the most resource-rich fragments (Banana & Turiho-Habwe, 1998; Richardson, 1993). The challenge to landholders, policy makers, and conservationists is to address access to resources while conserving habitat and biodiversity.

In densely settled landscapes where there is a culture of permanent settlement surrounding forest parks, a hard boundary (where limited to no access by communities is mandated and enforced) may be more appropriate (Naughton-Treves et al., 1998). Kibale is a successful example of such a park because its boundaries have remained intact with low incursion (Hartter, 2007). Together, in-migration, natural growth rates, and limited available land for agriculture have increased population density outside the park by 76% between 1980 and 2002 (Uganda Bureau of Statistics, 2005), thus placing increased pressure on forests to serve as resource pools and farmland. Since resource use within Kibale is restricted, the remaining forest fragments and wetlands are in jeopardy and almost certainly face eradication (Chapman et al., 2007).

Forest and wetland loss and fragmentation is one of the greatest challenges threatening global biological diversity (Chapman, Chapman, Crisman, & Kaufman, 2003; Laurance & Bierregard, 1997; Turner & Corlett, 1996), should not be overlooked since it has a direct bearing on resource scarcity and crop raiding. Fragmentation of the landscape not only has

impacts on the ability of households to secure land and resources, but also has detrimental impacts on ecosystem services and biodiversity (Tinker, 1997). Increased use of the forest fragments and wetlands means more edge has been created, fragment interiors have been opened, and they have become more accessible to hunting and other consumptive uses. Habitats and food supplies for wildlife within the fragments are shrinking, and the fragments that remain are becoming increasingly isolated within the agricultural mosaic. Wildlife must travel farther and ultimately cross through the agricultural matrix, or as shown with the vervet and redtail monkeys becoming persistent pests, will learn to live as part of a human-managed landscape, leading to human–wildlife contact, in turn leading to further forest conversion. Persistent loss of crops is encouraging landholders to engage in what they believe are preventative measures including the destruction of unprotected forests.

Chhetri, Mugisha, and White (2003) assert that once remnant forests and wetlands are destroyed or degraded beyond use, pressure on parks may increase. Conservationists face a two-fold challenge—one of quantity of fragments and species diversity and one of size and quality—which needs to be addressed from both sides. Smaller fragments are vulnerable to edge effects; tend to have impoverished interiors; and have higher mortality rates (Gascon, Williamson & da Fonseca, 2000; Laurance, Delamônica, Laurance, Vasconcelos, & Lovejoy, 2000). Larger fragments potentially have a higher conservation value and more resources, yet conserving large blocks of forests and reducing edge habitat in western Uganda has been identified as a management priority (Naughton-Treves et al., 1998). If conservation efforts focus solely on protecting larger fragments, however, those that live closer to a larger fragment will absorb a disproportionate amount of risk, similar to those neighboring the Kibale forest, while those are buffered by many farms or that are farther from the boundary are affected less.

There are some important limitations in this study that should be addressed in future research. While the perceptions of problems concur with previous social science research by Solomon (2007) and a decade earlier by Naughton-Treves (1997) and with conversations with long-term researchers and residents, it is important to understand whether these perceptions are representative of Kibale as a whole, not localized to certain areas. The responses might have been influenced by researchers and/or tourists and conservation activities that been conducted in these two study areas in the past. It is not evident how general these findings are, and it is important to test these findings within and among other ethnic groups or in other park landscapes in Uganda and other countries.

Conservationists must work toward a better understanding of fragment/human conflicts and the impacts of land-use decisions on different taxa within a park landscape. Work is needed to address resource needs and conflicts stemming from fragments that may have less conservation value, but more value to human livelihoods. The main finding is that local knowledge about the ecology and provisioning of small raiding animals is leading to destructive practices that may cause greater hardships and pressure on the parks because of the degradation and destruction of currently viable small fragmented forests. There is a need to study the ecological inter-relationships of pest animals to agricultural crops, and subsequently to help the community come to terms with living alongside wildlife rather than assuming a cropping strategy that is prone to raids and conflict.

Note

1. Landholdings in western Uganda are defined locally in acres.

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