

Evaluating a Union between Health Care and Conservation: a Mobile Clinic Improves Park-People Relations, Yet Poaching Increases

Dorothy Kirumira^{a,b}, Deborah Baranga^b, Joel Hartter^c, Kim Valenta^d, Charles Tumwesigye^a, Wilson Kagoro^a, and Colin A. Chapman^{e,f,g,#}

^aUganda Wildlife Authority, Kampala, Uganda

^bDepartment of Zoology, Kampala, Uganda

^cEnvironmental Studies Program, University of Colorado, Boulder, Colorado, USA

^dDepartment of Anthropology, McGill School of Environment, McGill University, Montreal, Quebec, Canada

^eDepartment of Anthropology, McGill School of Environment, McGill University, Montreal, Quebec, Canada.; Wildlife Conservation Society, Bronx, New York, USA

^fSection of Social Systems Evolution, Primate Research Institute, Kyoto University, Kyoto, Japan

^gEpidemiology of Highly Pathogenic Microorganisms, Robert Koch Institute, Berlin, Germany

#Corresponding author. E-mail: colin.chapman.research@gmail.com

Abstract

It is widely viewed that by providing employment or services to neighbouring communities, a protected area may increase positive attitudes towards conservation and discourage encroachment, but this is rarely tested. Our research examines this view by evaluating local attitudes towards the park and incidence of encroachment before and after the implementation of a novel conservation strategy – a mobile health clinic - in the predominantly agricultural communities bordering Kibale National Park, Uganda. The implementation of the mobile clinic programme coincided with a more positive attitude towards the park and a decrease in the number of people who ‘disliked’ the park. Despite this, the incidence of encroachment increased. There are a number of possible explanations for this contradiction, including respondents giving answers they believe will maintain the service they appreciate, and that while the local community may appreciate the mobile clinic, this appreciation is not sufficient to make people alter their behaviour because of tradition or need (e.g., the need among the very poor to feed their family or send a child to school is very high). Overall, people typically expressed that they did not have a problem with living adjacent to the park, except for the harm done by crop-raiding animals. However, local people expressed the view that they receive few benefits from the park – a perception that might be improved with more extensive use of the mobile clinic.

Keywords: Attitudes, health and conservation, Kibale National Park, mobile clinic, parks-people relationship, poaching, protected area, snare hunting

Access this article online

Quick Response Code:



Website:
www.conservationandsociety.org

DOI:
10.4103/cs.cs_17_72

INTRODUCTION

Estimates suggest that ~100 million ha of tropical forest were lost between 1980 and 2012 (Hansen and deFries 2004; Chapman et al. 2006; Hansen et al. 2013; Estrada et al. 2017) and that ~20% of the tropical forests were selectively logged between 2000 and 2005 (Potapov et al. 2008; Lewis et al. 2015). Temperatures are predicted to increase by 1.5°C by

the end of the twenty-first century due to climate change (IPCC 2014), and using moderate greenhouse gas emission estimates, it is projected that by 2100, 75% of all tropical forests present in 2000 will experience temperatures that are higher than those presently supporting closed canopy forests (Wright et al. 2009; Peres et al. 2016). Given these pressures on tropical forests and the fact that over half of the world's species are found in the tropics (Scheffers et al. 2012), one of the most prevalent tools used by conservationists to protect the world's biodiversity is the establishment of protected areas.

Since 1992, the global network of protected areas has grown steadily, increasing yearly by an average of 2.5% in total area (Butchart et al. 2010; Rands et al. 2010). By 2006, the global protected area network covered 24 million km², in 133,000 designated areas (Butchart et al. 2010; Rands et al. 2010). However, in a global analysis of 60 protected areas, Laurance et al. (2012) documented that researchers consider only ~50% of all reserves to have been effective over the last 20-30 years, while the remainder of the reserves are experiencing an alarming erosion of biodiversity (see also Tranquilli et al. 2014). Thus, a pressing question is: What makes some protected areas (national parks, forest reserves, and cultural reserves (hereafter, 'parks') effective, while others are not? One answer may involve the attitudes of neighbouring communities to conservation efforts (Naughton-Treves et al. 2011; Mackenzie 2012a).

Many communities living close to parks have negative attitudes towards them because their livelihoods depend on natural resources that exist in the protected areas, to which their access is restricted (Newmark et al. 1993; Mehta and Heinen 2001; Jacobson 2010; Coomes et al. 2011). Further, for predominantly agricultural communities whose livelihood depends on food crop production, attitudes are often negative because of the crop destruction caused by animals foraging on crops outside of the protected area (Naughton-Treves 1997, 1998; Naughton-Treves 1999; Archabald and Naughton-Treves 2001; Adams and Infield 2002; Mugisha and Jacobson 2004; Naughton-Treves et al. 2011). This is typically coupled with the fact that most of these communities receive no, or insufficient, compensation for their losses (Fungo 2011; Karanth et al. 2013; Chapman et al. 2016). The situation is made worse since protected areas are often located well away from economic centres that provide access to jobs and services, thus communities living next to parks are often poor (Brandon and Wells 1992; Naughton et al. 2011). Community-based conservation has been advocated as an approach to improve the lives of members of these poor communities, engender positive attitudes about the protected area, and promote conservation. Such claims make two assumptions. First, it is assumed that the community-based programme will lead to the local community viewing the protected area from a more positive perspective, and secondly, that this positive attitude will lead to reduced encroachment into the park (Western and Pearl 1989; Abbot et al. 2001; Hulme and Murphree 2001).

The objective of our research is to assess local attitudes toward a park and incidence of encroachment before and

after the implementation of a mobile health clinic in the predominantly agricultural communities bordering Kibale National Park, Uganda (hereafter Kibale). Prior to the implementation of the mobile clinic, health care was only accessible at brick and mortar clinics, which were often understaffed or lacked needed supplies, or at distant and expensive regional hospitals (Chapman et al. 2015). Health clinics and hospitals considered by the local community to offer suitable services often cost the equivalent of a days' wage for a local labourer, in addition to transport and other expenses. This was the situation when the first evaluation of the people's attitudes to the park was conducted. Subsequently, a mobile clinic was established that was operated by Uganda Wildlife Authority (UWA), the government agency that manages national parks. The mobile clinic, a refurbished ambulance, travelled around the park, bringing basic health care, family planning, deworming, HIV/AIDS treatment and counselling, vaccinations, and health and conservation education to remote communities around the park.

MATERIALS AND METHODS

Study Area and Population

Kibale National Park is a 795 km² mixed semi-evergreen forest and woodland-savannah protected area in south-western Uganda (Figure 1).

Kibale received its national park status in 1993, and prior to that it was a Forest and Game Reserve established between 1926 and 1932 with the goal of providing a sustained production of hardwood timber and a hunting area (Osmaston 1959; Struhsaker 1997; Chapman and Lambert 2000). Prior to the 1920s it was a hunting reserve for nobility since approximately 1800 (Mackenzie 2012a). Since the area was a Forest Reserve, entry and extraction of resources was illegal and the area was patrolled by armed rangers (Naughton-Treves 1999), as it at present. During the regimes of Idi Amin and Milton Obote, the difficult conditions for rural people and breakdown of many civil institutions led to settlers moving into the south of Kibale (Kibale Forest and Game Reserves) and clearing approximately 70 km² of forest (Hamilton 1984; Naughton-Treves 1999). Estimates of the number of people residing in this southern area of what is now Kibale National Park vary dramatically, but based on visiting the area in 1992 (CC), we believe that the most appropriate estimate is given by van Orsdol (1986), who, based on aerial (counting houses) and ground surveys estimated that 8,800 people were living in the Forest Reserve. The Makerere University Institute for Social Research report (MISR Makerere University Institute for Social Research 1989) estimates that between 42,000 and 57,000 people resided in the area, with some of these people having primary residence outside the reserve. Finally, the National Environmental Management Authority (1997) estimated that 30,000 households, or approximately 170,000 people, were residing in Kibale, but we view this number to be unreasonably high, as it was likely reported to encourage

foreign aid that was provided based on the number of people to be resettled. The resettlement worsened relationships with the people to the south and may have led to retribution-related behaviour (L'Roe and Naughton-Treves 2017; MacKenzie 2018); the area influenced one of the villages visited by the mobile clinic. The forced displacement of people resulted not only in hardship and loss, but restricted resource access (Brockington and Igoe 2006; Salerno et al. 2017) once thought to be available to the local community (West et al. 2006). This likely created animosity to the park, but the level may be tempered to a degree as many of the evicted likely knew they were encroaching on protected land and in fact many had agricultural plots both inside and outside of the park (Struhsaker 1997). Furthermore, as resource use in this area has been restricted for many generations (since the 1800s), people do not necessarily view that they hold entitlements over the resources in the park (Nampindo and Plumptre 2005).

Kibale is bordered by four districts (Kabarole, Kamwenge, Kasese, and Kyenjonjo), one town council, 14 sub-counties, 32 parishes, and 106 villages (Wilson Kagoro pers.comm. 2016). The population surrounding the park has increased seven-fold since 1920 and the density exceeds 270 people/km² along the western edge (Hartter 2010). Communities around Kibale are primarily subsistence agriculturalists from two dominant ethnic groups: Batooro to the north and Bakiga to the south (MacKenzie et al. 2011). Many of the people are recent immigrants to the region; in fact 56% of households migrated to the park borders in the last generation (MacKenzie 2012b).

There are other major changes that the farmers have had to deal with. For example, Kibale has experienced climate change well above the global average. The area receives 300 mm more rainfall per year than at the start of the last century, and the average maximum monthly temperature has increased by 4.4°C in the last 40 years (Chapman et al. 2010; Rothman et al. 2015). Corresponding to this change in climate, a number of tree species stopped fruiting (Chapman et al. 2005; Chapman et al. 2018). Three household surveys conducted in 2005, 2006, and 2009 indicated that farmers were most concerned not with the changes in the annual amount of rain, but rather with variable precipitation (Hartter et al. 2012). The variability makes it difficult to predict the best time to plant crops, and if a dry spell occurred after planting seedling mortality can be high and crop yield low.

The villages bordering the park suffer crop raiding by park animals (Naughton-Treves et al. 1998; Mackenzie and Ahabyona 2012) and are not compensated by the government because compensation for crop raiding is prohibited by the Wildlife Act for Uganda (Hartter 2009) and because of the logistical and financial difficulties of compensation. While the impact of different crop raiding animals has changed overtime (MacKenzie et al. 2017), elephants and baboons (*Papio anubis*) are currently considered large problems (Naughton-Treves et al. 1998) see below) and elephant populations have increased exponentially in Kibale (Omeja et al. 2014; Omeja et al. 2016).

A number of programmes are in place to improve the lives of the people living next to the park and to help them

with hardships associated with being neighbours of the park (i.e., crop raiding by the park's animals, particularly elephants, and scarcity of fuelwood (Naughton-Treves et al. 2007; Naughton et al. 2011; Ross 2013; Chapman et al. 2016). These measures are not a hundred per cent effective (i.e., it is not possible to keep all of the elephants within the park and crop raiding does occur), so the mobile clinic system we evaluate here is an additional service provided to the local communities. For example, there is an education programme that provides standard education plus education about the park to 10,000 children in 14 schools (Kasenene and Ross 2008; Ross 2013) and a fuelwood project provides seedlings of species suitable for fuelwood. Also, since 2007, Kibale has had a health clinic operated by UWA located immediately adjacent to the park at Makerere University Biological Field Station that serves the neighbouring communities (i.e., within an hours' bike ride). This health center offers basic services but is only accessible to a small proportion of the people around the park (i.e., within biking distance).

The mobile clinic we investigate is linked to the UWA outreach and conservation education activities and was intended to provide health care as a tangible benefit to neighbouring communities. These communities often lack the revenue needed for medical services (Fink et al. 2011; Goldberg et al. 2012), as the adult employment rate in communities near Kibale is only 22% (MacKenzie 2012), and due to a poor 'savings culture,' even employed community members do not have the financial means to cope with medical emergencies. The mobile clinic initially had only one nurse to provide services, with a doctor available for consultation, but UWA immediately realised this was insufficient and requested assistance from the Ministry of Health and an additional 3-4 nurses from the local clinics joined in the daily operations. The clinic targets villages with high incidences of crop raiding and illegal activities and as a form of compensation for crop losses due to wild animals, which is an aspect of social responsibility that is a part of UWA's mandate (UWA 2002). For many community members living close to the park's boundary, seeking assistance from the mobile clinic saves transport costs as services are delivered near their home.

The mobile clinic facilitates interaction between the community and UWA, often involving town hall style meetings. These meetings have multiple purposes: 1) to create a forum for the public to express concerns related to the park; 2) UWA Community Outreach Wardens conduct informational sessions related to conservation and environment; and 3) mobile health clinic nurses and/or UWA staff provide health education. With respect to creating a forum, focus groups involving community leaders (LC 1 to 5), indicated that people often felt that park officials were not listening to the hardships they face. Hence the visit of the mobile clinic was an opportunity for UWA to reach out to the public and hear their stories and where possible respond to rectify a problem. If a solution was not possible, UWA had the opportunity to tell the community why they could not fix their problem, often telling the community about their limitations (e.g., the impossibility

to have a warden at every elephant crop raiding event around the 229 km perimeter of the park). Sometimes the discussions about UWA's limitations led to compromise solutions being proposed that could be tailored to specific locations and communities. For example, if elephant crop raiding damage was considered a significant burden on a community, funds from the park's revenue program could be directed to help the community dig elephant trenches (MacKenzie 2012b). With respect to conservation and environmental education, UWA has a long-standing goal of building the pride that the community has in the park and its wildlife. Thus, information was given about the special features of certain species (e.g., how caring elephant mothers are, or the strength of chimpanzees) and details of the ecosystem services the park provided (e.g., the swamps within the park clean water making it more palatable for drinking).

The discussions about health include information on sanitation (e.g., the need to boil water, how to construct a tippy-tap), the value of mosquito nets, how AIDS is contracted and how to prevent getting infected, and for groups of women - family planning. Hulme (1997) found that the impacts of benefits in changing attitudes and engendering local support was enhanced by regular contacts between the wildlife staff and local communities. Thus, the goal was that by having the mobile clinic regularly visit the communities, not only could health care be given more effectively, but conservation messages could also be given when community members were considering engaging in prohibited activities in the park.

Survey Methods

Individuals living in five sub-counties, five parishes, and six villages that border the park were interviewed one month before and nineteen months after the implementation of the mobile clinic program (Figure 1). As is standard in Kibale when contacting the local communities to collect such data (MacKenzie 2012b; Chapman et al. 2016), prior to starting the interview process permission was sought from the local village chairperson. As per cultural norms, the chairman informed the community that we would be talking to people, but she/he did not communicate the topic of the interviews to the people. Stratified random sampling first based on distance from the park boundary was used to select villages. Studies on crop-raiding in the region found that farms closer to the park boundary are more susceptible to crop raiding (Naughton-Treves 1998; Chiyo and Cochrane 2005; Chiyo et al. 2005; Omeja et al. 2014). Similarly, elephant crop damage is confined to <200m of the park boundary (Rode et al. 2006). The villages were subsequently selected based on poaching and crop raiding incidences using Management Information System (MIST) and Spatial Monitoring and Reporting Tool (MIST/SMART) reports made by UWA and interviews with park employees. The most disgruntled villages due to losses incurred as a result of crop raiding are an outreach priority for UWA and were selected. The reason for poaching varies

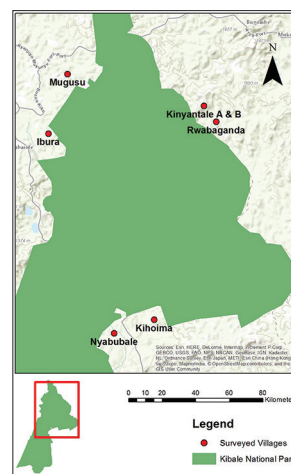


Figure 1

Map of Kibale National Park, Uganda and the villages where the Mobile Health Clinic provided health services to (basic health care, family planning, deworming, HIV/AIDS treatment and counselling, vaccinations, and health and conservation education) and used in the surveys reported here

among communities, but has been investigated in detail (Solomon et al. 2007; MacKenzie and Hartter 2013).

Between May and June 2014 and May and June 2016, 144 semi-structured household interviews were conducted, 72 during each period. To facilitate the reception of the interviewer, a local field assistant who was well-known in the area was hired to help arrange the interviews. The research had the approval of UWA and the Office of the President. The survey itself was examined, commented upon, and after revision, approved by the McGill University Research Ethics Board.

The survey instrument was pre-tested to train the field assistant and to assess clarity and the perception of the researchers. The survey was written in English, translated into the two local languages (Rutooro and Rukiga) by a local community member, and then back-translated into English by two different community members. All interviews were conducted by DK, who speaks the local languages very well, with the help of a local field assistant. Prior to starting the interview, we read a standard text about the interview (see Supplementary Material) and discussed with the person that we were not looking for any specific answer nor would there be any reward, monetary or otherwise, for answering in a particular fashion. The interview team arrived using local means, at a different time than the mobile clinic, which should have separated DK's association with the UWA's efforts with the mobile clinic. Only women were interviewed for a number of reasons— women tend to have more negative attitudes towards the park (Naughton-Treves 1997; Naughton et al. 2011), and tend to be the ones responsible for food-crops, while men are responsible for cash crops that are less frequently raided (two-thirds of all guarding is done by women and children (Hill 2000)). Furthermore, if a person in the family is employed, it is typically the man, making them less concerned about crop raiding (Naughton-Treves 1997). Finally, the

interviewers often had to travel considerable distance using local means to get to the villages being sampled, and while women were frequently at the home or easy to find, men were rarely around the home.

In total, 144 households within 300m of the park boundary were randomly selected from the study villages. If the female head of the household was not at home at the time or was not easy to find (e.g., working in the fields close by) for the interview, the household was rejected and another household was randomly selected from a list of households in villages neighbouring the park and identified in UWA reports as experiencing high levels of crop raiding and high incidence of poaching in the neighbouring forest (see below). Surveys were conducted in local languages, either Rutoro or Rukiga. Following a series of questions to gather basic information about the composition of the interviewed populations, interviews consisted of mostly closed-ended questions, but respondents could further expound on their initial responses. To evaluate perceptions of park-related benefits, we asked respondents to rank the importance of perceived benefits the park provided both before the mobile clinic was operating and after (Very important = 1, Important = 2, Fairly important = 3, No opinion = 4, Not important = 5; see Table 1). As members of the local community may have different ideas of what is a benefit than our research team, we used previous surveys by Chapman, Hartter, and Mackenzie (see cited references) to determine what were the most widely viewed benefits (see supplementary information and Table 1). We describe how much the communities 'liked' the park on a 1 to 5 Likert scale. A similar 5-point ranking was used to describe how satisfied the community was with the services provided by the mobile clinic, which we used to interpret our results and to inform the UWA staff. Responses were then coded into categories for data analysis. Changes in the preference for different types of benefits were analysed using Chi Squared test, while individual changes in categories of how much respondents 'liked' the park were analysed using Z tests. Pearson correlations were used to examine temporal trends in incidence in encroachment.

We also gathered information on encroachment into the park using UWA ranger patrol data (total = 499 patrols that were typically a day long). UWA sends out patrols to prevent and monitor encroachment into the park on a regular basis (on average 9.2 days a month). The patrols record any incidence of encroachment, including snares (86.3%), pit traps (7.0%), logging, charcoal, and fuelwood collection (5.5%), sightings of hunters (0.1%), setting fire (0.1%), and other (1%), and note their location. With respect to bushmeat it is believed that the majority of the offtake is for subsistence use only. A small amount makes it to the local market, but there is no evidence of large scale commercial harvest of wildlife in the area. UWA made their records available to us between January 2012 and June 2016, and we analysed the incidence of encroachment of different types for each month. Since patrolling effort was variable over the year, often depending on the number of rangers available to send out, we standardised these values by the number of patrols per month.

RESULTS

Study Population

Overall, 68.1% of the respondents were between 20 and 39 years of age, 20% were between 40 and 59, 6.3% were over 60, and 5.6% were between the minimum ages of 18 and 19. The largest proportion of the interviewees (59.7%) completed primary school, while 11.8% had a secondary level education, and only 0.7% had above-secondary education. The remainder (26.4%) did not complete primary school (Table 2). One of the reasons offered by respondents for children dropping out of school was that the household loss of crops due to the 'park's animals' meant that the family did not have sufficient funds to send all of their children to school or because they were forced to pull the children from school to help guard gardens against crop-raiding animals (see also Mackenzie et al. 2015).

The average number of people in a household was seven, with 53.5% of the households having 1-5 people, 42.4% having 6-10 people, 3.5% having 11-15 people, and 0.7% having over 16 people. Large households were often the result of relatives dying from HIV/AIDS and the household adopting the relatives' children. Overall, 19.4% of households were supported by less than half a hectare of land (self-reported), 38.9% had between ½ and one hectare, 36.1% of the households have more than a hectare. Approximately, 5% did not own land and instead rented land for farming.

Table 1
The preference of benefits offered by Kibale National Park, Uganda to households adjacent to the park before and after the implementation of a mobile health clinic

Benefit	Rank	Before (%)	After (%)	P
Revenue sharing	Very important	1.4	8.3	P<0.001
	Important	1.4	18.1	
	Fairly important	0	18.1	
	No opinion	95.8	38.9	
	Not important	1.4	16.7	
Resource access	Very important	19.4	9.7	P<0.001
	Important	16.7	16.7	
	Fairly important	4.2	29.2	
	No opinion	58.3	15.3	
	Not important	1.4	29.2	
Rainfall	Very important	2.8	29.2	P<0.001
	Important	6.9	31.9	
	Fairly important	2.8	29.2	
	No opinion	87.5	0	
	Not important	0	9.7	
Market for goods	Very important	1.4	5.6	P<0.1
	Important	0	5.6	
	Fairly important	0	8.3	
	No opinion	98.6	44.4	
	Not important	0	36.1	
Mobile clinic	Very important		47.2	
	Important		29.2	
	Fairly important		13.9	
	No opinion		1.4	
	Not important		8.3	

To evaluate perceptions of park-related benefits, we asked respondents to rank the importance of perceived benefits on a 5-point Likert scale both before the mobile clinic was operating and after (Table 2). People were more likely to have an opinion about the benefits after the mobile clinic had been operating than before, possibly the result of obtaining information at the conservation education sessions given by the mobile clinic staff (statistical analysis reported in Table 2). After the mobile clinic had been operating for 19 months the perceived importance of each benefit tended to increase, although the proportion that did not view the benefits as important also rose (Table 2).

Use of the Mobile Clinic

By the second phase of research the mobile clinic had operated for 19 months, made 176 village visits, and served 19,820 patients, of whom 57.2% of were women, 28.8% men, and 13.8% children. It was difficult to estimate the number of people gathering around the mobile clinic to listen to the conservation and health information provided, but large audiences (100-200 people) often gathered to see what was happening or simply to listen to the music and enjoy the festive atmosphere that the mobile clinic's visit engendered. However, it was estimated that 70% of the people that received health

care listened to both health and conservation messages and also participated in the question and answer sessions (Natamba, D. and R. Asiimwe. pers.comm. 2016). We estimated that the number of people who visited the mobile clinic in some fashion and heard health and conservation messages that UWA delivered was approximately 200,000 people (the proportion of repeat versus new visitors is unknown). Many children would gather around the former ambulance to listen to music or simply out of curiosity.

After the mobile clinic had operated for 19 months, 86.1% of the women interviewed knew about the clinic. Most of these women acknowledged that it had visited their sub-county, while 5.6% of the respondents said the mobile clinic had not visited their sub-county when it had, and 11.1% said they did not know if the mobile clinic had visited their sub-county. Of the people interviewed, 37.5% had sought services from the mobile clinic at least once. Some interviewees (30.3%) that had not visited said they did not know when the mobile clinic was visiting on the day it came, but they said they would have very willingly attended if they knew when it was coming. The majority (56.9%) of the women interviewed heard about the mobile clinic's visit either directly from the community leader who UWA informed (33.3%) or indirectly from another community member that the community leader had informed (23.6%; Table 3). This word-of-mouth communication was surprisingly efficient because only 8.3% of the women did not learn about an upcoming mobile clinic visit in time to use the services. We placed paid announcements on the radio on six occasions at what we thought were the best times of the day to have people listening to the radio, but this proved relatively ineffective because only one person reported hearing the radio announcement.

The mobile clinic provided a number of health services to the local community (Table 3). People sought treatment primarily for nurse or doctor consultations for injuries or common illnesses (e.g., flu), free HIV testing and counselling, and

Table 2

Basic demographic information, education, and wealth indices of the study population that were used to evaluate the mobile clinic operating around Kibale National Park, Uganda. Livestock ownership provides an approximate index of both wealth and ability to persevere following crop loss, is the ownership of domestic animals (Naughton et al. 2011)

Category	# per Category	% in Category
Age		
Below 20	8	5.6
20-40	98	68.1
40-60	29	20.1
60-80	9	6.3
Level of Education		
Primary	86	59.7
Secondary	17	11.8
Tertiary	1	0.7
None	38	26.4
Number of people in the household		
1-5	77	53.5
5-10	61	42.4
10-15	5	3.5
15+	1	0.7
Land ownership		
Inherited	48	33.3
Rented	12	8.3
Bought	84	58.3
Owning domestic animals		
Cows	24	16.7
Goats	90	62.5
Pigs	71	49.3
Chickens	67	46.5

n=144 (72 from phase one and 72 from phase two)

Table 3

Method/media by which local community members around Kibale National Park, Uganda learnt about the mobile clinic and treatment or service the clinic provided. The sample is based on 72 interviews conducted 19 months after the mobile clinic had been operating

	% of respondents
Media	
Community head	33.3
Word of mouth	23.6
Church announcement	20.8
Others	12.5
Radio advertisement	1.4
Not heard about it	8.3
Services received	
Nurse or doctor consultation	86.1
HIV testing or treatment	34.7
Conservation Education	30.6
Syphilis Testing	15.3
Malaria testing	11.1
Malaria treatment	6.9

syphilis and malaria testing and treatment. On one occasion, the mobile clinic was able to distribute 1500 free reading glasses (0.5 to 3.0 magnifications), primarily to the elderly.

Park-People Relationships

Both poaching records obtained from UWA's ranger patrols and responses from the survey indicate recent changes in illegal activities; however, the direction of change is not the same. Over 50% of the survey participants stated that each type of illegal activity was decreasing (Figure 2).

Setting fires was an exception, whereby only 23% of the respondents indicated a decline and 34% did not know what the trend was as they stated that fires were not set in their area of the park. After 19 months of the mobile clinic operating, 64% of the respondents estimated that illegal herb and craft material collection was reducing, as well as poaching (67%), illegal logging (66%), while 55% of the respondents said that snare setting was going down. Other illegal activities, such as the collection of medicinal plants, were reported, but each were mentioned by less than 1% of the respondents and there was no change in the reporting of these activities before and after the implementation of the mobile clinic program. In conversations, local people often attributed the decline in illegal activities to increased patrolling by UWA; the records kept by UWA also indicate that the number of days spent patrolling each month increased over time ($r_{sp} = 0.355$, $p = 0.004$). Respondents also attributed the decline in poaching to the benefits acquired from living adjacent to Kibale. Additionally, most respondents (81.9%) stated they would report illegal activities to park authorities or to the local council chairperson (LC1, similar to a village 'mayor'), because if they do not they fear losing the benefits acquired from living next to the park. However, people also remarked that they feared retaliation from the accused person or their family and 18.1% stated that they would not report illegal activities because members of their family were former

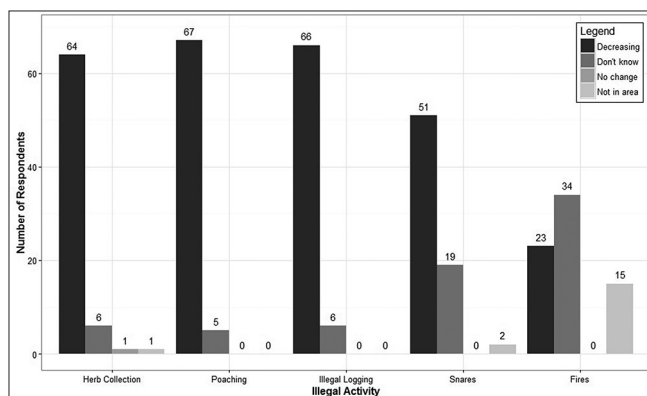


Figure 2

Respondents' perceived change about the most common illegal activities occurring in Kibale National Park, Uganda between May 2014 and May 2016. The category 'Not in area' means that people did not view that this type of activity was not happening in the vicinity of the village. For example, in areas of the park that do not have grasslands, fires cannot be set

poachers and they could imagine what the person they reported on would go through if arrested.

Prior to the mobile clinic programme, only 6.9% of the respondents categorised their relationship with the park as 'like Kibale very much', while 19 months after the establishment of the mobile clinic, 81.9% liked the park very much. Potentially more important from the perspective of decreasing poaching, while 37.5% of the local people disliked the park before the mobile clinic was operating, only 1.4% disliked it after 19 months of operation; similarly, 31.9% of the respondents 'somehow disliked the park' prior, but only 1.4% people responded in this fashion afterward (Figure 3; statistical differences indicated in the figure; a notable, but non-significant, decline was observed in the 'dislike it very much' category). The main reason given during conversations for disliking the park was that the park's animals destroy crops.

In general, the majority (76.3%) of the women in the local communities stated that they very strongly agreed that the mobile clinic positively influenced the way they regarded the park, and 18.1% strongly agreed, while 4.2% were uncertain, and 4.2% said the mobile clinic had not affected their view of the park. Those who were uncertain were all individuals who had either not used the mobile clinic because they had not heard when it would arrive, or individuals who disliked the park. The vast majority (97.2%) said the mobile clinic had generally improved community attitudes towards the park, while only 2.8% said it did not. Overall, 76.4% of the respondents stated that their relationship with UWA was very good, while 16.7% rated it as good, and 6.9% considered it fairly good. None of the respondents said their relationship was very bad. This response could have been biased by the fact that respondents knew of or suspected a relationship between the interviewing team and UWA; however, we made it clear to the people being interviewed that we were not seeking a particular response and there was no reward, financial or otherwise, for answering in a particular way.

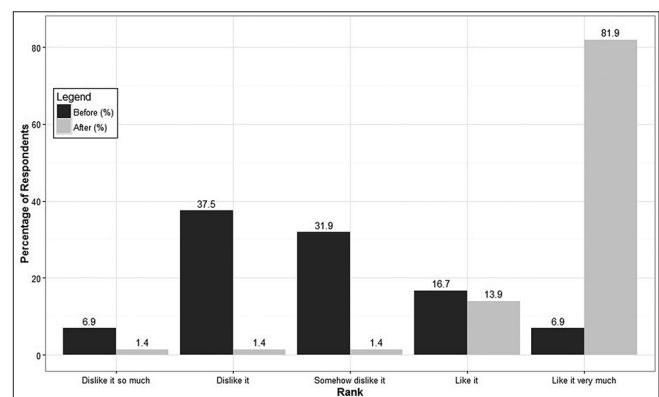


Figure 3

*Percentage of respondents in each of five categories related to how respondents feel about the park, before and after the MHC. * denotes a significant difference between percentage of respondent before and after in each category. Dislike it so much z-score = 1.6681, $p = 0.047$. Dislike it z-score = 5.4745, $p = 0.00$. Somehow dislike it z-score = 4.9193, $p = 0.00$. Like it z-score = 0.4633, $p = 0.32$. Like it very much z-score = -9.0561, $p = 0.00$. Alpha value set to 0.05, no post-hoc alpha correction, all analyses 1-tailed*

During the interviews 7% of women stated that they had issues with the park because UWA did not respond when called to help deal with problems of crop-raiding animals. Just over 19% of the respondents stated that their relationship with park officials was good and they did not have any trouble with the park officials, but rather that their problems were with crop raiding animals.

Nevertheless, in contrast to what the local people stated, UWA patrols reported an increase in all types of encroachment between January 2011 and June 2016 (Figure 4).

Only the most commonly reported type of hunting - setting snares - increased significantly over time ($r_{sp} = 0.323$, $p = 0.017$), and setting fire ($p = 0.31$) and timber extraction ($p = 0.25$) were rarely reported and did not show a significant trend over time.

DISCUSSION

The mobile clinic delivered medical treatment to approximately 1000 people a month, and it is estimated that UWA staff and the nurses delivered health and conservation education to ten times that number. These events also allowed the community to interact with park staff to express their grievances and understand the park's side of the conservation situation. These actions appeared to have been appreciated by the local community as they coincided with an increase in the proportion of people who 'liked' the park and a decrease in the number of people who 'disliked' the park. We suspect the people who disliked the park are those most likely to take negative actions against the park. In terms of protecting biodiversity, the activity of the mobile clinic was coincident with the communities' perceptions that encroachment into the park was declining; however, the number of incidences of encroachment recorded by the park rangers actually increased during this time, particularly the setting of snares. This increase in encroachment corresponded with UWA's increased frequency of patrols.

The contradiction between local communities reporting that encroachment was decreasing and UWA documenting that it was increasing may be interpreted in a number of ways:

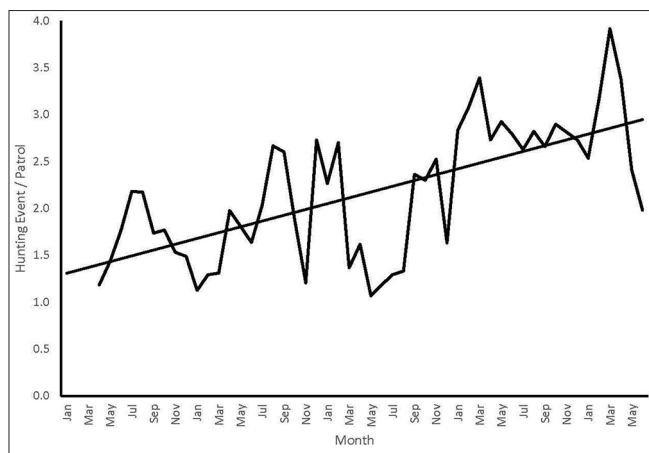


Figure 4

Incidence of hunting (snares (wire and rope), pit traps, and sighting of hunters) in Kibale National Park, Uganda per patrol conducted by rangers of Uganda Wildlife Authority between January 2011 and June 2016 ($R=0.323$, $P=0.017$)

1) It is possible that the local people do appreciate the service, and thus have answered in a calculated way to ensure the services continue by giving the answer they believe that UWA wants to hear – namely that poaching is declining as a result of the mobile clinic. We tried to minimise this possibility (see methods), but the possibility of this bias still exists. In general, people responding to survey questions that deal with sensitive questions or issues that affect the benefits they receive must be interpreted with care (Solomon et al. 2007).

2) Alternatively, the increase in the number of hunting incidences documented by UWA rangers may indicate an improvement in the ranger's ability to detect snares - the most frequent evidence of hunting. However, there is no reason to think that rangers increased their efficiency in detecting snares, as there were no unusual changes in staff or increased training in snare detection.

3) It is likely that only a few individuals are engaged in snare hunting and the benefits that the mobile clinic provides may have not reached those individuals. Only men tend to enter the park to set snares, but only 28.8% of the people served by the mobile clinic were men, making this suggestion all the more likely.

4) The surveys reflect the opinions of the part of the community believed to be most concerned about the park issues – the women. Thus, it does not reflect the men who are entering the park to engage in prohibited activities; however, sampling the opinions of those engaged in prohibited behaviours is very difficult (Solomon 2007; Solomon et al. 2007). In terms of prohibited activities, including snares, pit traps, jaw traps, sightings of hunters, timber harvest, fuelwood collection, all are only conducted by men. Only fuelwood collection is typically carried out by women and children (fuelwood collection is likely under recorded because deadwood is collected and this leaves few signs). Thus, by not gathering the opinion of men, not only did we not consider the proportion of the population receiving fewer benefits from the mobile clinic (point 3), but we did not survey the segment of the population conducting the majority of the prohibited behaviours – setting snares.

5) Another possibility is that people may be appreciative, but not so much that they are willing to alter their behaviour. Possibly the tradition of bushmeat hunting is well established or the need for the bushmeat may be great (e.g., the need among the very poor to feed their family or the desire to send a child to school). It must be kept in mind that evaluating non-compliance of laws, such as those related to bushmeat hunting, is very difficult and requires a careful selection of methods (Solomon et al. 2015).

These possible explanations raise a number of avenues for future research and point towards different management options. Future research should probe into whether people actually believe that encroachment is declining or if this is the answer they think they should give to maintain the services of the mobile clinic. It is clear that it would be very insightful to find out who is poaching and determine their characteristics: are these individuals in financial need and if so what is the need? What cultural group do they come from

(Duffy et al. 2016; Knapp et al. 2017)? Do they sell meat for financial gain or for family consumption (Damania et al. 2005)? If this research proves that the men who are encroaching are poor, then it may be possible to target outreach and services to the poorest people. Currently many of the benefits the park provided to the local community target those most affected by crop raiding (e.g., establishing elephant trenches) or the middle class (e.g., school construction and school fee support). In the future outreach could target men. Finally, protecting biodiversity could be enhanced by increasing the disincentive to encroach into the park.

Our results suggest that providing what are perceived as tangible benefits may be an effective way to influence attitudes towards conservation. People appreciate direct individual benefits more than communal benefits and thus individual benefits are more likely to influence positive attitudes towards conservation (Ferraro and Kiss 2002; Mackenzie 2012a). Within Uganda and many other countries, this is partly because the funds invested in communal projects do not meet the expectations of the beneficiaries, and communities often complain that the funds get squandered or misdirected to the benefit of a few (Mugisha and Jacobson 2004; Smith and Walpole 2005; MacKenzie 2012b). Providing health benefits is a direct, tangible benefit to an individual or that individual's family. When one's life, or that of a loved one, is in danger, health care is viewed as critical (Fink et al. 2011; Goldberg et al. 2012). However, unfortunately for communities surrounding remote national parks, health care is typically a 'luxury' that is simply not available (this sentiment was frequently stated during conversations with the local communities around Kibale and 'luxury' is the term most often used). The Millennium Assessment states that health care is a right of every individual (Sachs and McArthur 2005). Thus, the unfortunate scarcity of health care can be turned into a win-win opportunity for conservation and neighbouring communities.

A very tangible advantage that the provision of health care offers over other conservation strategies, such as ecotourism and revenue sharing, is that mobile clinics provide conservation education and a means for the communities to repeatedly express their grievances and views to protected area managers. With the mobile clinic this can be done around the whole perimeter of the protected area (229 km), something that most site-based programmes, such as school programmes, cannot achieve (Mugisha and Jacobson 2004; Jacobson 2010). Conservation education during mobile clinic visits offers regular contact between park and UWA staff and communities, and regular contact alone may enhance local support for conservation (Hulme 1997; Holmes 2003). For example, when visiting communities, the community members expressed a strong desire to have their concerns heard by park managers, particularly with respect to crop raiding. Thus, a programme was developed to allow community members to state their concerns about animals leaving the park and express their thoughts on what needed to be done to rectify the problem of the 'park's animals'. This allowed communities that were angry with the park to feel more understood, appreciated, and

sympathised with. It also allowed staff to more fully understand the local situation and develop appropriate measures to help the communities. For example, UWA developed a simple SMS phone messaging system that permitted community members to easily communicate elephant crop raiding and for UWA to respond more rapidly to such elephant raids (Sarkar et al. 2016). By facilitating more effective communication and making community members feel more understood and appreciated, the mobile clinic may increase the communities' cooperation with conservation efforts, but this remains to be tested.

Overall, given the financial limitations of UWA and the health needs of the communities' neighbouring Uganda's national parks, mobile clinic programmes appear to be an effective way to benefit local communities, enhance park-community communication, and provide conservation education. Whether it will improve biodiversity conservation (our results suggest it does not) will need to be examined over a longer period, as education has time to have an impact and more people perceive benefits. Local perceptions of the programme could be improved by involving the community more in the services provided and other aspects of the decision-making process, enhancing financial transparency so the local community can understand why more services cannot be provided, and by facilitating a more festive atmosphere (Vidal-Garcia et al. 2016), so more people attend the education sessions.

CONCLUSION: SYNTHESIS AND IMPLICATIONS

Our research demonstrated that a mobile clinic operating around Kibale National Park, Uganda was correlated with an increase in the proportion of the neighbouring community who 'liked' the park and a decrease in the number of people who 'disliked' the park. The activity of the mobile clinic was coincident with the community's perception that encroachment into the park was declining; however, the number of incidences of encroachment recorded by the park rangers actually increased. We outline a number of possible explanations for this contradiction, ranging from respondents giving answers they believe will maintain a service they appreciate, to the possibility that while the local community may appreciate the mobile clinic, this appreciation is not sufficient to make people alter their behaviour because of tradition or need (e.g., the need among the very poor to feed their family or send a child to school is very high). These possible explanations raise a number of avenues for future research and point towards different management options. For example, identifying who is poaching and their characteristics would provide valuable management insights ranging from increasing disincentives to programmes helping the very poor. Providing health benefits is a direct, tangible benefit to individuals (i.e., when one's life, or that of a loved one, is in danger, health care is critical) that promote positive attitudes towards parks. Our findings suggest that linking health to conservation promotes positive park-people interactions and that, given the financial limitations of many park services in the tropics and the health needs of neighbouring communities, this linkage warrants

further application and careful investigation. However, since we did not find that as attitudes to the park increased encroachment decreased, caution should be used with applying this approach, and investigations of the health-conservation linkage over a longer period are needed, as education has time to have an impact and more people benefit.

ACKNOWLEDGEMENTS

Funding for the research in Kibale National Park was provided by the Canada Research Chairs Programme, Natural Science and Engineering Research Council of Canada, Fonds Québécois de la Recherche sur la Nature et les Technologies, and the National Geographic Society. Permission to conduct this research was given by the National Council for Science and Technology, the Office of the President, and Uganda Wildlife Authority. We particularly thank Uganda Wildlife Authority for the study leave given to DK to conduct this project, for their provision of the data on encroachment, and for their continuous and vitally important logistical support. We thank the Kasiisi Project who funded the operating costs of the mobile clinic September 2015-September 2016 and provided clinical staff. We are also indebted to the staff of the Mobile Clinic for their help in the field and to Catrina MacKenzie and David Tumusiime helpful comments on this project.

REFERENCES

- Abbot, J.I., D.H. Thomas, A.A. Gardner, S.E. Neba, and M.W. Khen. 2001. Understanding the links between conservation and development in the Bamenda Highlands, Cameroon. *World Development* 29(7): 1115–1136.
- Adams, W.M. and M. Infield. 2002. Who is on the gorilla's payroll? claims on tourist revenue from a Ugandan National Park. *World Development* 31(1): 177–190.
- Archabald, K. and L. Naughton-Treves. 2001. Tourism revenue sharing around national parks in western Uganda: early efforts to identify and reward local communities. *Environmental Conservation* 28(2): 135–149.
- Brandon, K.E. and M. Wells. 1992. Planning for people and parks: design dilemmas. *World Development* 20(4): 557–570.
- Brockington, D. and J. Igoe. 2006. Eviction for conservation: a global overview. *Conservation and Society* 4(3): 424.
- Butchart, S.H., M.M. Walpole, B. Collen, A. van Strien, J.P.W. Scharlemann, R.E.A. Almond, J.E.M. Baillie, et al. 2010. Global biodiversity: indicators of recent declines. *Science* 328(5982): 1164–1168.
- Chapman, C.A. and J.E. Lambert. 2000. Habitat alteration and the conservation of African primates: case study of Kibale National Park, Uganda. *American Journal of Primatology* 50(3): 169–185.
- Chapman, C.A., L.J. Chapman, T.T. Struhsaker, A.E. Zanne, C.J. Clark, and J.R. Poulsen. 2005. A long-term evaluation of fruiting phenology: importance of climate change. *Journal of Tropical Ecology* 21(1): 31–45.
- Chapman, C.A., M.J. Lawes, and H.A.C. Eeley. 2006. What hope for African primate diversity? *African Journal of Ecology* 44(2): 1–18.
- Chapman, C.A., L.J. Chapman, A.L. Jacob, J.M. Rothman, P.A. Omeja, R. Reyna-Hurtado, J. Hartter, et al. 2010. Tropical tree community shifts: implications for wildlife conservation. *Biological Conservation* 143(2): 366–374.
- Chapman, C.A., B. van Bavel, C. Boodman, R.R. Ghai, J.F. Gogarten, J. Hartter, L. E. Mechak, et al. 2015. Providing health care to improve community perceptions of protected areas. *Oryx* 49(4): 636–642.
- Chapman, C.A., A. DeLuycker, R.A. Reyna-Hurtado, J.C. Serio-Silva, T.B. Smith, K.B. Strier, and T.L. Goldberg. 2016. Safeguarding biodiversity: what works according to the conservation community. *Oryx* 50(2): 302–307.
- Chapman, C.A., K. Valenta, T.R. Bonnell, K.A. Brown, and L.J. Chapman. 2018. Solar radiation and ENSO predict fruiting phenology patterns in a 16-year record from Kibale National Park, Uganda. *Biotropica* 50(3): 384–395.
- Chiyo, P.I. and E.P. Cochrane. 2005. Population structure and behaviour of crop-raiding elephants in Kibale National Park, Uganda. *African Journal of Ecology* 43(3): 233–241.
- Chiyo, P.I., E.P. Cochrane, L. Naughton, and G.I. Basuta. 2005. Temporal patterns of crop raiding by elephants: a response to changes in forage quality or crop availability? *African Journal of Ecology* 43(1): 48–55.
- Coomes, O.T., Y. Takasaki, and J.M. Rhemtulla. 2011. Land-use poverty traps identified in shifting cultivation systems shape long-term tropical forest cover. *Proceedings of the National Academy of Sciences* 108(34): 13925–13930.
- Damania, R., E. Milner-Gulland, and D. Crookes. 2005. A bioeconomic analysis of bushmeat hunting. *Proceedings of the Royal Society of London B: Biological Sciences* 272(1560): 259–266.
- Duffy, R., F.A. St John, B. Büscher, and D. Brockington. 2016. Toward a new understanding of the links between poverty and illegal wildlife hunting. *Conservation Biology* 30(1): 14–22.
- Estrada, A., P.A. Garber, A.B. Rylands, C. Roos, E. Fernandez-Duque, A. Di Fiore, K. A.I. Nekaris, et al. 2017. Impending extinction crisis of the world's primates: why primates matter. *Science Advances* 3(1): e1600946.
- Ferraro, P.J. and A. Kiss. 2002. Direct payments to conserve biodiversity. *Science* 298(5599): 1718–1719.
- Fink, G., I. Gunther, and K. Hill. 2011. The effect of water and sanitation on child health: evidence from the demographics and health surveys 1986–2007. *International Journal of Epidemiology* 40(5): 1196–1204.
- Fungo, B. 2011. A review of crop raiding around protected areas: nature, control and research gaps. *Environmental Research Journal* 5: 87–92.
- Goldberg, T.L., S. Paige, and C.A. Chapman. 2012. The Kibale EcoHealth Project: exploring connections among human health, animal health, and landscape dynamics in western Uganda. In: *Conservation medicine: applied cases of ecological health* (eds. Aguirre, A.A. and P. Daszak). New York, NY: Oxford University Press.
- Hamilton, A.C. 1984. *Deforestation in Uganda*. Oxford: Oxford University Press.
- Hansen, M.C. and R. deFries. 2004. Detecting long-term global forest change using continuous fields of tree-cover maps from 8-km advanced high resolution radiometer (AVHRR) data for the years 1982–1999. *Ecosystems* 7(7): 695–716.
- Hansen, M.C., P.V. Potapov, R. Moore, M. Hancher, S.A. Turubanova, A. Tyukavina, D. Thau, et al. 2013. High-resolution global maps of 21st-century forest cover change. *Science* 342(6160): 850–853.
- Hartter, J. 2010. Resource use and ecosystem services in a forest park landscape. *Society and Natural Resources* 23(3): 207–223.
- Hartter, J., M.D. Stampone, S.J. Ryan, K. Kirner, C.A. Chapman, and A. Goldman. 2012. Patterns and perceptions of climate change in a biodiversity conservation hotspot. *Public Library Of Science One* 7: e32408.
- Hill, C.M. 2000. Conflict of interests between people and baboons: crop raiding in Uganda. *International Journal of Primatology* 21(2): 299–315.
- Holmes, C.M. 2003. The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. *Oryx* 37(3): 305–315.
- Hulme, D. 1997. *Community conservation in practice: a case study of Lake Mburo National Park, Uganda*. CCIA PAPER NO. 3, IDPM.
- Hulme, D. and M. Murphree. 2001. *African wildlife and livelihoods: the promise and performance of community conservation*. Kampala: Fountain Publishers.
- IPCC. 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the*

- Intergovernmental Panel on Climate Change (eds. Pachauri, R.K. and L.A. Meyer). Geneva: IPCC.
- Jacobson, S.K. 2010. Effective primate conservation education: gaps and opportunities. *American Journal of Primatology* 72(5): 414–419.
- Karanth, K.K., L. Naughton-Treves, R. DeFries, and A.M. Gopalaswamy. 2013. Living with wildlife and mitigating conflicts around three Indian protected areas. *Environmental management* 52(6): 1320–1332.
- Kasenene, J. and E. Ross. 2008. *Community benefits from long-term research programs: a case study from Kibale National Park, Uganda*. Cambridge, UK: Cambridge University Press.
- Knapp, E.J., N. Peace, and L. Bechtel. 2017. Poachers and poverty: assessing objective and subjective measures of poverty among illegal hunters outside Ruaha National Park, Tanzania. *Conservation and Society* 15(1): 24.
- L’Roe, J. and L. Naughton-Treves. 2017. Forest edges in western Uganda: from refuge for the poor to zone of investment. *Forest Policy and Economics* 84: 102–111.
- Laurance, W.F., D. Carolina Useche, J. Rendeiro, M. Kalka, C.J.A. Bradshaw, S. P. Sloan, S. G. Laurance, et al. 2012. Averting biodiversity collapse in tropical forest protected areas. *Nature* 489: 290–294.
- Lewis, S.L., D.P. Edwards, and D. Galbraith. 2015. Increasing human dominance of tropical forests. *Science* 349(6250): 827–832.
- MacKenzie, C., C.A. Chapman, and R. Sengupta. 2011. Spatial patterns of illegal resource extraction in Kibale National Park, Uganda. *Environmental Conservation* 39(1): 38–50.
- MacKenzie, C. and J. Hartter. 2013. Demand and proximity: drivers of illegal forest resource extraction. *Oryx* 47(2): 288–297.
- Mackenzie, C.A. 2012a. Accruing benefit or loss from a protected area: location matters. *Ecological Economics* 76: 119–129.
- MacKenzie, C.A. 2012b. Trenches like fences make good neighbours: revenue sharing around Kibale National Park, Uganda. *Journal for Nature Conservation* 20(2): 92–100.
- MacKenzie, C.A. 2018. Risk, reciprocity and retribution: choosing to extract resources from a protected area. *Ecological Economics* 143: 314–323.
- Mackenzie, C.A. and P. Ahabyona. 2012. Elephants in the garden: financial and social costs of crop raiding. *Ecological Economics* 75: 72–82.
- MacKenzie, C.A., J. Salerno, C.A. Chapman, R. Reyna-Hurtado, D.M. Tumusiime, and M. Drake. 2017. Changing perceptions of protected area benefits and troubles around Kibale National Park, Uganda. *Journal of Environmental Management* 200: 217–228.
- Mackenzie, C.A., R.R. Sengupta, and R. Kaoser. 2015. Chasing baboons or attending class: protected areas and childhood education in Uganda. *Environmental Conservation* 42(4): 373.
- Mehta, J.N. and J.T. Heinen. 2001. Does community-based conservation shape favorable attitudes among locals? an empirical study from Nepal. *Environmental Management* 28(2): 165–177.
- MISR (Makerere University Institute for Social Research). 1989. *Settlement in Forest Reserves, Game Reserves, and National Parks*. Kampala, Uganda: Makerere University.
- Mugisha, A.R. and S.K. Jacobson. 2004. Threat reduction assessment of conventional and community-based conservation approaches to managing protected areas in Uganda. *Environmental Conservation* 31(3): 233–241.
- Nampindo, S. and A. Plumpre. 2005. *A socio-economic assessment of community livelihoods in areas adjacent to corridors linking Queen Elizabeth National Park to other protected areas in Western Uganda*. Wildlife Conservation Society, Albertine Rift Programme, Kampala, Uganda.
- Naughton-Treves, L. 1997. Farming the forest edge: vulnerable places and people around Kibale National Park, Uganda. *Geographical Review* 87(1): 27–49.
- Naughton-Treves, L. 1998. Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. *Conservation Biology* 12(1): 156–168.
- Naughton-Treves. 1999. Whose animals? a history of property rights to wildlife in Tooro, Western Uganda. *Land Degradation and Development* 10(4): 311–328.
- Naughton-Treves, L., A. Treves, C.A. Chapman, and R.W. Wrangham. 1998. Temporal patterns of crop raiding by primates: linking food availability in croplands and adjacent forest. *Journal of Applied Ecology* 35(4): 596–606.
- Naughton-Treves, L., D.M. Kammen, and C. Chapman. 2007. Burning biodiversity: woody biomass use by commercial and subsistence groups in western Uganda’s forests. *Biological conservation* 134(2): 232–241.
- Naughton, L., J. Alix-Garcia, and C.A. Chapman. 2011. A decade of forest loss and economic growth around Kibale National Park, Uganda: lessons for poverty reduction and biodiversity conservation. *Proceedings of the National Academy of Sciences* 108(34): 13919–13924.
- Newmark, W.D., N.L. Leonard, H.I. Sariko, and D.G.M. Gamassa. 1993. Conservation attitudes of local people living adjacent to five protected areas in Tanzania. *Biological Conservation* 63(2): 177–183.
- Omeja, P.A., A.L. Jacob, M.J. Lawes, J.S. Lwanga, J.M. Rothman, C. Tumwesigye, and C.A. Chapman. 2014. Changes in elephant density affect forest composition and regeneration? *Biotropica* 46(6): 704–711.
- Omeja, P.A., M.J. Lawes, A. Corriveau, K. Valenta, F.P. Paim, and C.A. Chapman. 2016. Recovery of the animal and plant communities across large scales in Kibale National Park, Uganda. *Biotropica* 48(6): 770–729.
- Osmaston, H.A. 1959. *Working plan for the Kibale and Itwara Forests*. Entebbe: Ugandan Forest Department.
- Peres, C.A., T. Emilio, J. Schiatti, S.J. Desmoulière, and T. Levi. 2016. Dispersal limitation induces long-term biomass collapse in overhunted Amazonian forests. *Proceedings of the National Academy of Sciences* 113(4): 892–897.
- Potapov, P., A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, et al. 2008. Mapping the world’s intact forest landscapes by remote sensing. *Ecology and Society* 13(2): 51.
- Rands, M.R.W., W.M. Adams, L. Bennun, S.H.M. Butchart, A. Clements, D. Coomes, A. Entwistle, et al. 2010. Biodiversity conservation: challenges beyond 2010. *Science* 329(5997): 1298–1303.
- Rode, K.D., P.I. Chiyo, C.A. Chapman, and L.R. McDowell. 2006. Nutritional ecology of elephants in Kibale National Park, Uganda, and its relationship with crop-raiding behaviour. *Journal of Tropical Ecology* 22(4): 441–449.
- Ross, E. 2013. The role of small NGOs: building quality international education. *Harvard International Review* 35(1): 40.
- Rothman, J.M., C.A. Chapman, T.T. Struhsaker, D. Raubenheimer, D. Twinomugisha, and P.G. Waterman. 2015. Cascading effects of global change: decline in nutritional quality of tropical leaves. *Ecology* 96(3): 873–878.
- Sachs, J.D. and J.W. McArthur. 2005. The millennium project: a plan for meeting the millennium development goals. *The Lancet* 365(9456): 347–353.
- Salerno, J., C.A. Chapman, J.E. Diem, N. Dowhaniuk, A. Goldman, C.A. MacKenzie, P.A. Omeja, et al. 2017. Park isolation in anthropogenic landscapes: land change and livelihoods at park boundaries in the African Albertine Rift. *Regional Environmental Change* 18(3): 1–16.
- Sarkar, D., C.A. Chapman, W. Kagoro, and R. Sengupta. 2016. Countering elephant raiding with short message service: challenges of deploying public participation-based systems in a setting with sparse Information Communication Technologies resources. *The Canadian Geographer/Le Géographe canadien* 60(4): 493–504.
- Scheffers, B.R., L.N. Joppa, S.L. Pimm, and W.F. Laurance. 2012. What we know and don’t know about Earth’s missing biodiversity. *Trends in ecology & evolution* 27(9): 501–510.
- Smith, R.J. and M.J. Walpole. 2005. Should conservationists pay more attention to corruption? *Oryx* 39(3): 251–256.

- Solomon, J. 2007. *An evaluation of collaborative resource management and the measurement of illegal resource use in a Ugandan National Park*. Gainesville: University of Florida.
- Solomon, J., S.K. Jacobson, K.D. Wald, and M. Gavin. 2007. Estimating illegal resource use at a Ugandan park with the randomized response technique. *Human Dimensions of Wildlife* 12(2): 75–88.
- Solomon, J.N., M.C. Gavin, and M.L. Gore. 2015. Detecting and understanding non-compliance with conservation rules. *Biological Conservation* 189(September 2015): 1–4.
- Struhsaker, T.T. 1997. *Ecology of an African rain forest: logging in Kibale and the conflict between conservation and exploitation*. Gainesville: University of Florida Press.
- Tranquilli, S., M. Abedi-Lartey, K. Abernethy, F. Amsini, A. Asamoah, C. Balangtaa, S. Blake, et al. 2014. Protected areas in tropical Africa: assessing threats and conservation activities. *Public Library Of Science One* 9: e114154.
- UWA (Uganda Wildlife Authority) 2002. *Kibale National Park – General Management Plan 2003-2013*. Kampala, Uganda: Uganda Wildlife Authority.
- van Orsdol, K. G.K.G. 1986. Agricultural encroachment in Uganda’s Kibale Forest. *Oryx* 20(2): 115–117.
- Vidal-Garcia, F., D. Hernández-Rodriguez, J.C. Serio-Silva, and C.A. Chapman 2016. *Mono arana: El Acrobata de la selva*. Xalapa, Mexico: Secretaria de Educación de Veracruz.
- Western, D. and M.C. Pearl. 1989. *Conservation for the twenty-first century*. New York: Oxford University Press.
- Wright, S.J., H.C. Muller-Landau, and J. Schipper. 2009. The future of tropical species on a warmer planet. *Conservation Biology* 23(6): 1418–1426.

Received: May 2017; Accepted: July 2018

