Research stations as conservation instruments provide long-term community benefits through social connections

Abstract

Conservation plans have evolved beyond biodiversity protection to include the welfare of the communities surrounding protected areas. Local community engagement initiatives include development of ecotourism, revenue sharing arrangements, and resource access agreements. Though research stations are common in African National Parks, their contribution to biodiversity protection and community benefits have seldom featured in the literature. Here, we consider whether community benefits accruing from field research stations are effective and how they may promote community-park relationship. We employ a mixed methods approach to understand the impacts on the local community of a field station located in Kibale National Park, Uganda. We find that the presence of the research station provides long-term direct employment for 52 people, and indirect, cascading benefits for up to 720 people several kilometers away. Additionally, the research station is associated with other important community benefits, primarily healthcare and education. While benefits of the research station do not eliminate community-park conflict, the long-term presence of researchers and the gains to local people associated with them is an underappreciated and important means to better integrate the goals of biodiversity protection and local community investment

Keywords: conservation evaluation, economic benefits, community perception, inclusive conservation plans, research station, social impact, park-people interaction

Introduction

The rhetoric on management plans for Protected Areas (PAs) has focused extensively on the costs and benefits of delineating large areas for biodiversity protection, while accounting for the welfare of local communities. While PAs have generally been effective at biodiversity protection (Struhsaker, Struhsaker, and Siex 2005; Laurance et al. 2012), they have often been accused of exacerbating poverty by disenfranchising neighboring communities (Ninan, 2006; Nyhus et al., 2005). Over the years, expectations of conservation plans have broadened to encompass the welfare of people living around the PAs (Robinson 1993; Daniels and Bassett 2002; Miteva, Pattanayak, and Ferraro 2012; Martin, McGuire, and Sullivan 2013). These community welfare initiatives have taken various forms including ecotourism, revenue sharing, resource access agreements, health care, and education (Ferraro, Hanauer, and Sims 2011; Child 2013; Chapman et al. 2015). Focused and sustained efforts to improve the livelihood of nearby communities have generally assuaged the reputation of PAs as poverty traps (Ferraro, Hanauer, and Sims 2011; Naughton-Treves, Alix-Garcia, and Chapman 2011; Mackenzie 2012); however, the best methods for managing PAs in light of local community needs remain contentious (Miteva, Pattanayak, and Ferraro 2012).

Persistent threats to Earth's biodiversity intensifies the urgency to set aside land for protection. Since 1992, PAs have grown steadily, and as of 2006, they covered 24 million km^2, in 133,000 designated areas (Butchart et al. 2010; Rands et al. 2010). This surge in the size and number of PAs raises the concomitant challenge of ensuring that PAs do not disenfranchise local people. Creation of new PAs to maximise conservation without doing so at the expense of the socioeconomic well-being of adjacent communities requires treading a fine balance between the often conflicting requirements of biodiversity conservation, human rights, and development

goals (Robinson 1993; Zimmerer 1994, 2006; Wilshusen et al. 2002; Brockington, Igoe, and Schmidt-Soltau 2006). Most biodiversity hotspots are located in the world's poorest countries (Cincotta, Wisnewski, and Engelman 2000; Fisher and Christopher 2007) where attempts to conserve land by excluding local people can impact their tenuous livelihoods (Guha 1989; DeFries et al. 2005). In addition to opportunity costs in the form of reduced access to natural resources, there are also issues such as increased crop raiding by park-protected animals (Naughton-Treves 1998; Mackenzie and Ahabyona 2012), eviction (Brockington, Igoe, and Schmidt-Soltau 2006; Karanth 2007), and threats to personal safety (Packer et al. 2005; Inskip et al. 2013). While in some cases the development of ecotourism has been effective in off-setting these costs, developing a vibrant ecotourism industry is not always a viable option and funds from tourists often do not diffuse to local communities, thus proving inadequate at providing substantial economic incentives for the local communities to protect biodiversity (Krüger 2005; Child 2013). For example, through gorilla ecotourism in Bwindi Impenetrable National Park, the local community received approximately $400,000 annually via revenue sharing agreements, yet the high population density around this park makes the individual benefit negligible (Sandbrook and Adams 2012). Whether this small amount of money can alter the perception of the local communities is questionable (Karanth et al. 2012). Community-based conservation efforts developed partly in reaction to state-run exclusionary conservation (Wilshusen et al. 2002), have achieved mixed success in linking biological conservation objectives with local development endeavours (Campbell and Vainio-Mattila 2003) and have managed to provide only modest supplements to local livelihoods (Kiss 2004). Thus, many PAs are left with limited

opportunities to fulfill the mandate of ensuring community welfare alongside biodiversity protection.

We present data on a rarely discussed means of enhancing community welfare, while simultaneously protecting biodiversity – the promotion of long-term research stations. Like eco-tourism, a research field station provides opportunities for economic gains. In addition, research stations are not constraint to PAs with attractions such as large mammals and often have researchers spending significant amount of time and returning for several years, thus building a relationship with the place and the people. A large scale study to find correlates of conservation success revealed that 37.5 % of PAs in Africa have research stations (Struhsaker, Struhsaker, and Siex 2005) and that PAs with a research station were better able to evaluate success and management of PAs, even when research activities usually covered only 2–3 % of the PA's area. Here, we focus on Makerere University Biological Field Station (MUBFS), a long-term research station in Kibale National Park, Uganda. We have use snowball interviews to understand how MUBFS impacts livelihoods and consequently how the community perceives MUBFS.

Study Area

Located in Western Uganda, Kibale National Park (Kibale) is a 795 km^2 mid-altitude moist evergreen forest (Figure 1). At the start of the 19th century the area was a large forest inhabited by approximately 40 households of agriculturists (Naughton-Treves 1998, 1999). In 1932, Kibale became officially recognized as a forest reserve with the goal of providing sustained hardwood timber production (Struhsaker 1999; Chapman and Lambert 2000). In the 1920s the Uganda Game Department was tasked with confining wild animals to parks, to enable growth of agricultural land

without hindrance of wild animals (Karanth et al. 2013; Naughton-Treves 1999a; Naughton-Treves 1998). The focus of Kibale shifted to biodiversity conservation in 1993, when Kibale's status was changed from forest reserve to a national park under the stewardship of the Uganda Wildlife Authority (UWA). UWA manages PAs in Uganda using the 'Park and Neighbour' strategy (Jones 2006), where conservation research, community education and outreach, resource access agreements, and revenue sharing are vital components of management (Mugisha and Jacobson 2004; Mackenzie, Sengupta, and Kaoser 2015).

Research intensified in the area around 1970 and became localized in the Kanyawara area with the work of Dr. Thomas Struhsaker from the Wildlife Conservation Society (WCS). In 1987, the operations of the growing field station were handed over to Makerere University and the site was named Makerere University Biological Field Station (MUBFS). The field station infrastructure grew substantially in the early 1990s through international funding. Currently, MUBFS consists of three research sites, Kanyawara, Ngogo and a newly developed site at Sebatoli, but the major site remains Kanyawara (Figure 1). Kibale's history of human impacts in terms of commercial logging/agricultural clearing and its location in an area conducive to working with the local community made the site a focal point for conservation research. In the early 1990s with grants from the European Union and USAID, the field station grew in terms of the logistics that it could offer researchers and field courses. Today, MUBFS is considered by some to be Africa's leading tropical forest research, conservation, and training site (Box et al. 2008).

We focus on Kanyawara, which is the primary site housing administrative offices, lodging, classrooms, library, a mess hall and kitchen, laboratory space, and medical facilities <Insert pictures>. Kanyawara currently employs 52 people of which

78.8 percent are from nearby villages. The number of people reported as employed by MUBFS are the ones who are ones in their payroll as administrative and support staff (primarily house keeper and trail cutters). People are also engaged on a temporary basis in capacities of cooks and housekeepers for researchers and field courses. In addition to the jobs offered directly by MUBFS, researchers hire Field Assistants (FAs) and long-term projects often hire several FAs with yearly renewable contracts. FAs tend to be from nearby villages, typically living within 6 Km of the field station.

Several outreach and development projects have been started near the field station by researchers working in Kibale (Table 1).The Kasiisi Project was set up by researchers from Harvard University in 1997 to enhance local education by improving school infrastructure. Even though Uganda has implemented free universal primary education (Oketch and Rolleston 2007), public schools are often overcrowded, understaffed, and lack basic infrastructure (Deininger 2003). In addition to lacking amenities such as school uniforms, school supplies, and books, children are faced with the trade-off of going to school versus helping with agricultural activities including guarding crops against the park's animals (Ross 2013; Mackenzie, Sengupta, and Kaoser 2015; MacKenzie, Moffatt, et al. 2017). This project has assisted over 10,000 children in 14 schools (Ross 2013) and has carried out several outreach activities (Project 2016).

In 2007, researchers and students from McGill University established the Kibale Health and Conservation Centre (KHCC) to provide medical services to the community (Bunting 2008; Chapman et al. 2015). The primary goal of the centre was to provide free consultation and at-cost medication to the local community. The center is located at one of the park's entrances, and employs a full-time nurse and a

medical advisor whose responsibilities include outreach activities for disease prevention. From September 2008-September 2012, the centre provided care to 7,200 people and its outreach programme extended to 4,500 schoolchildren each year (Chapman et al. 2015). Since 2012, the addition of a Mobile Health Clinic (MHC) has expanded the reach of some of the health services provided by KHCC as well as conservation education outreach to areas surrounding the whole of the national park. The MHC caters to the plight of remote villages for basic health care, family planning, HIV/AIDS treatment, counselling, and vaccinations.

Data and Analysis Methods

We use a mixed method approach comprised of household surveys and focus groups to capture local community perceptions of the field station and to understand the extent to which socio-economic life is affected by the research station. The survey primarily comprised of questions inviting descriptive answers and a few multiple-choice questions and was administered to 70 employees of the field station representing residents of 13 surrounding villages and the field station. To evaluate how the benefits from the station percolated through the community, each employee and FA hired by researchers were asked to list people they hired for various household and farming related activities, who were in turn interviewed and again asked who they employed. Thus, a snowball sampling approach was used that started with administering the surveys to people working at MUBFS and then consequently expanding it to people who are hired by them for household and farm work and so on and so forth. Since one of our aims is to understand the community's perception of the benefits of a field station, the snowball sample thus allows us a closer look into how the perception of the people change as they are further removed

from directly economically benefiting from MUBFS. to control for the self-selecting bias of the snow-ball sampling method. In addition to interviewing people who directly or indirectly benefit from the field station, the survey was also administered to 27 randomly selected respondents who were not a part of the snowball chain . These 27 respondents will be referred to as the Control Respondents (CR).The respondents from the field station and FAs are referred to as Tier 1 responders and each consequent referral is denoted as Tier 2, Tier 3, and so forth. The surveys were administered between January 2016-May 2017 by a Ugandan field assistant to minimize the bias associated with the respondents interacting directly with researchers. As many chains (connected Tiers) as possible were followed (i.e., until an individual on the chain did not hire a person to help them). The primary limitation to following some chains to completion was the unavailability or unwillingness of an individual to participate in the survey and if an individual lived more than 10 km from the field station.

Most of the survey questions were descriptive in nature to elicit as many themes as possible. The descriptive survey questions along with the large number of survey respondents meant that a considerable amount of data was gathered as free form text. This text was analysed using Latent Dirichlet Allocation (LDA) (Blei, Ng, and Jordan 2012) fitted with Gibbs sampling to automatically elicit topics latent in the discussions. The optimum number of topics latent in the corpus was determined by running the algorithm repeatedly to discover three to ten topics. The result of the algorithm where it was instructed to extract 5 topics was determined to be optimum, producing the most logical topic to term allocation. The extracted topics were further clarified and discussed by conducting six focus groups. Each focus group was comprised of three to four employees of the field station. The participants were given

the set of topics discovered thus far and were specifically asked if there were topics that they wanted to discuss. After about 150 interviews, which included four tiers of snowball sampled participants, the focus groups agreed that persistent points had been covered and new information was unlikely to emerge. However, a few more surveys were administered to participants in Tier 5, 6, 7, and to the CRs to double check the completeness of information received.

On returning from the field, qualitative analysis was performed where by the interviews were manually coded and themes elicited. The extracted themes from the coding closely represented the ones found through LDA. To extrapolate the results of the survey and to get an understanding of how many secondary jobs were created through the employments at the field station, Geographically Weighted Regression (GWR) was used with the number of people from each village employed at the field station and the distance of the village from the field station as explanatory variables. The predicted output from GWR was used to create a surface depicting the secondary job potential using Inverse Distance Weighting (IDW).

Results

The snowball sampled respondents consisted of 209 people from 21 villages (including people who lived at the field station itself) within 10 km by road from the field station. Of these, 148 were men and 61 were women. There was a male bias in Tier 1, with 90 percent of the people interviewed being male, while only 61 percent of the people in subsequent tiers were male. Out of the 70 people interviewed in Tier 1, 40 were FAs of researchers and the remaining 30 people were administrators, cooks, and trail cutters. The people in the remaining Tiers (Tier 2 = 118 people, 3=8, 4=5, 5=5, 6=2, 7=1) primarily subsist with small scale agriculture supplemented by

payments from the employees of the field station. These individuals were employed to assist with agriculture and cattle grazing (63 %), helping around the household (13 percent), construction (12 percent), and in brickmaking (12 percent). There were 27 CRs from 9 villages consisting of 12 men and 15 women, 66 percent of whom were farmers. Thus, in total there were 236 respondents from 21 villages including the field station (Table 2). It is worth noting the varying number of respondents in each Tier impacts the demographic results. Overall, Tier 1 respondents demonstrated better indicators of wealth by having larger number of livestock, and greater proportion of households had eucalyptus and cash crop plantations compared to all other Tiers and CRs. Tier 1 respondents also reported higher education levels. Across the various education and wealth indicators, the CRs are comparable to Tier 2 respondents.

The topics revealed by LDA (Table 2) provide a snapshot into the themes that were later confirmed by interview coding. The following sub-sections discuss the themes in context of four over-arching motifs; economic benefits, crop raiding, resource access, and community-park relationship. These themes are consistent with the broad topics discussed in the literature focusing on the community around KNP <cite?>. However, while the studies focus primarily on the impacts of conservation plans on the community, our study aimed to understand how the research field station has affected the communities and consequently, the responses received provides insight on how MUBFS has contributed to these themes.

Economic benefits

The most apparent community benefit of the field station was employment. The field station typically employs 52 people (Table 1), and 88.6 percent of Tier 1 respondents subsequently hired people to work in their household or farms. Most Tier 1

respondents (62.2 percent) stated that they would/could not have hired additional labour if they did not have a job at the field station. These findings explain why the most commonly cited benefit of the field station was employment, which was also recognized by 21.5 percent of the people not employed at the field station (includingCR).

CRs also iterated that employment in MUBFS is mostly available to the educated:

"Some inhabitants have been employed in the park but only those who are educated."

and recognised the trickle-down effects of the employment benefits, who also acknowledge that the economic benefits from MUBFS flow primarily through social connections (friends and family):

"…others get jobs from friends who are working in the park"

Each person hired created on average 2.3 (S.E.=0.11) additional job opportunities for their community members (Figure 2). The majority (93 percent) of the hiring was from the villages < 3 km from the field station, but some employees traveled up to 8 km along dirt roads to get to work (Figure 3). In contrast, Tier 2 was mostly local. The mean distance between Tier 2 employees and their employers was 0.9 km. A Geographically Weighted Regression (GWR) with number of Tier 2 respondents at each location as the dependent variable of number of Tier 1 employees and the distance of the location from the field station was used to extrapolate the Tier 2 employment potential around the park (R^2 = 0.617) (Figure 4). Since, Tier 2 jobs tend to be local, they are concentrated around the villages with most people employed by the field station; however, as Tier 1 jobs were correlated with distance from the field station, the number of Tier 2 jobs also reduced with

distance from the field station. Extrapolating the results of the survey to all employees living in nearby villages including the FAs, the field station helps support approximately 158 secondary employment opportunities in villages located within 5 km. The CRs on the other hand employ 1.7 (S.E.=0.29) additional people on average. Apart from employment opportunities, the field station also created economic opportunities akin to the ones created by ecotourism, such as sales of farm produce and crafts to researchers and students. Another recurrent economic benefit that emerged from the surveys was gifts received from researchers. When surveys are conducted, respondents stated that researchers reimbursed their time with small gifts, like soap, sugar, or mosquito nets. Moreover, unlike eco-tourism sites, researchers spend long periods in the field station, often coming back for several years. This often fosters congenial relationships between employees and researchers. Several people employed as FAs have identified benefits like help with their children's education from educational projects and direct payment from researchers. Indeed, 61 percent of people employed at the field station reported receiving advances or sponsorship from researchers for various reasons, most commonly children's education. Despite efforts such as the Kasiisi Project to make education accessible, the general cost of continuing education remains high and making getting sponsorship for children's education was one of the most cited benefits of working for the field station, as exemplified by the following comment of a Tier 2 respondent:

"Because one is working in the park, he has sponsors helping his child [for education]"

Crop Raiding

Researchers have reiterated the miseries of the community due to crop-raiding animals, particularly baboons and elephants (Naughton-Treves 1998; Mackenzie and Ahabyona 2012). The same concerns were raised during our interviews and crop-raiding was reported as the most common negative effect of living next to a PA (63.98 percent including CRs). Locals consider wildlife as state property and believe that UWA should be accountable for animal's actions. However, the community recognises the efforts of the researchers to provide insights into how to tackle the crop-raiding problem. For example, the revenue sharing model employed by the park has been used to excavate and maintain trenches (MacKenzie 2012), and 11.02 percent of the respondents (including CRs) recognized trench excavation and maintainance as an useful expenditure. The plight of the community and the constant attention from researchers have made UWA more responsive to the night-time calls from villages seeking help to drive away elephants , and researchers and UWA have developed a protocol for villagers to report elephant raiding and gather data for understanding spatio-temporal patterns of raids (Sarkar et al. 2016). However, rangers scare shooting elephants at night to drive them back into the forest is an unnerving experience, as pointed out by several respondents, exemplified by the following response:

"When Elephants come out rangers shoot bullets leaving the community too scared of death…"

Resource Access

Resource Access Agreements (RAAs) have been persistent points of contention in community-park relationships. RAA permits involved keeping beehives in the park, collecting craft materials, and fishing. Previously the agreement allowed firewood

and/or NTFPs collection, but these activities were discontinued due to exhaustion of resources or due to non-compliance with regulations (Mackenzie, Chapman, and Sengupta 2011). Nonetheless, the local dependence on firewood for cooking means that illegal fuelwood extraction remains a common practise. In the interviews, lack of legal access to firewood was a frequently voiced grievance (26.27. percent including CRs), and the presence of international researchers in the park was held responsible for the heightened vigilance of the community and UWA regarding illegal resource extraction. Efforts by the researchers (through the Kibale Fuel Wood Project) have helped raise awareness of planting Eucalyptus for firewood and a handful of people said that they grow their own trees for firewood (34.74 percent including CRs, Tier 1 = 54.28 percent, 2 = 29.66 percent, 3 = 12.5 percent, 4, 5, 6 and 7 = 0 percent, CR = 29.63 percent) while a similarproportion (36.01 percent including CRs) of respondents were depended on friends' and neighbours' plantations or collected firewood from the park. Access to medicinal plants was another similar strain of complaints regarding restrictions on resource access. The blanket ban on extraction of NTFPs have also restricted the community from accessing the medicinal herbs and plants found in the park that are used in traditional medicine. The plight of the community resonates with the people employed at MUBFS (Tier 1 respondents) and when asked for suggestions for improving community park relationships, two Tier 1 respondents suggested holding more workshops to raise awareness on alternate fuels for cooking.

Community Park Relationship

The park and its animals are often viewed by community members as state property and of little use to locals. People's reaction to the park is often mixed with the positive perceptions attained from employment countered by the negative

perceptions of being excluded from resources and the damage caused by crop raiding animals (Hartter and Goldman 2009). However, researchers working on livelihood issues around Kibale have often worked as a liaison between UWA and the community, helping to change the perception of the park. In fact, one interviewee stated that:

"Before it [perception of the park] was bad. Rules were hard to follow, now things are better. Researchers help to solve problem. … fees collected to help building trenches"

Research field stations are uniquely positioned to enhance community engagement and conservation. Unlike eco-tourism sites, the people working in research sites are more invested in conservation by virtue of being involved in a set-up focused on enquiries on conservation. People employed in the park re-iterated that outreach workshops conducted by the field station and UWA were beneficial in spreading awareness about *"the importance of a forest"*, *"conservation and its use"*, and *"how the park operates"* and one individual stated:

"Community understand now the good in the park because of Mzungos (foreigners) coming from very far to make their studies [research] in the park"

Overall, when asked about the community's perception of the park, the respondents in the snowball sample (Tiers) had a mixed response (29.66 percent positive, 4.66 percent neutral, 8.9 percent negative, 56.36 percent can't say), with the CRs were more agnostic with a high percentage of neutral responses (29.63 percent positive, 37.03 percent neutral, 22.22 percent negative, 11.11 percent can't say). Unsurprisingly, Tier 1 respondents were most positive (40 percent) about the community's perception of the park with the positivism declining with Tiers (Tier 2= 27.11 percent, 3= 35 percent, 4, 5, 6 and 7= 0 percent). However, even the CRs

(29.6 percent) noted that presence of researchers has helped raise awareness about the benefits of conservation while 37.03 percent mentioned the convenience of the KHC and the various education opportunities available.

Discussion and Conclusion

The community around KNP has been well studied to understand the impacts conservation activities on people living around PAs (Naughton-Treves 1997, 1998; Lepp and Holland 2006; Hartter and Goldman 2009; Hartter and Southworth 2009; Naughton-Treves, Alix-Garcia, and Chapman 2011; Mackenzie and Ahabyona 2012; Mackenzie and Hartter 2013; MacKenzie, Moffatt, et al. 2017). However, our research is the first to attempt to isolate the role of the long-term research field station (MUBFS) on the community. A large number of interviews were thus required to ensure that we have captured the different perceptions about MUBFS in the community along with understanding how MUBFS impacts livelihoods. However, the major themes elicited were consistent with the topics discussed previously, but, we were able to provide new insights pertaining to the relationship between MUBFS and the community.

Previous research around Kibale had highlighted that perceptions of the park vary in the community (Hartter and Goldman 2009; MacKenzie, Salerno, et al. 2017). The negative impacts of living next to a protected area were somewhat mitigated by policies for revenue sharing, resource access, and opportunities for employment and tourism. This article highlights that several of the positive measures can at least partially be attributed to the presence of a long-term research field station. The research station not only provide employment opportunities, but has also catalyzed the setting up of several welfare projects in the area. Thus, MUBFS has not only acted as a platform for scientists to conduct their research in Kibale, but has also

evolved over the years to provide service to the community mainly through the efforts of researchers conducting long-term research in the area.

Our results indicate that the benefits from the field station spread out to the local community and progressively grew over time. The 52 people hired directly resulted in the hiring of 2.3 times that number, or 120 people. If these 120 people belonged to different households, an estimated 720 people obtain financial benefits from the station (average household contains six people (Mackenzie and Hartter 2013). These people purchased goods and services, spreading the benefits even further. Respondents indicated that the people providing these goods and services recognize they are benefitting from funds from the field station. The results revealed that the economic benefits spread along social connections but people spatially and socially closer to MUBFS also has access to other benefits such as education subsidies and secondary employment opportunities. This spread of benefits appears to be substantial, but to guide planning, evaluating relative effectiveness of different approaches must be made with respect to at least five considerations. **First**, community benefits must be significant enough to alter the perception of the local community and thereby affect behaviour. If the density of the population neighboring a field station is low, even small amounts of financial gain from the project can translate to large individual gains. In Africa, the density of people outside parks is often high, and on average only 4 percent of the communities derive financial benefit (Struhsaker, Struhsaker, and Siex 2005). In Kibale, the population near the park's boundary is around 300 people/km^2 (Hartter 2009). Thus, the impact of fund distribution to the 720 people considered to benefit from the field station is relatively small and needs careful evaluation.

Second, administrators should compare the benefits of the research station to other conservation schemes. In general, comparisons of different schemes are rare and difficult to make, stemming partly from the fact that the schemes operate at different temporal scales (e.g., cash benefits are immediate, but benefits of education may require decades to have an impact). Like the salary benefits of the field station, ecotourism provides financial benefits to people who are employed or sell goods and services. Tourism in Kibale attracts approximately 7700 visitors each year, creating part-time employment for approximately 250 people and generating $271,000 in revenue (Mackenzie 2012). Given the large population around Kibale, tourism provides direct income to only 0.5 percent of the population. This income spread equally among community members bordering the park, would translate into $1.08 per year *per capita*. Whether this amount is sufficient to alter community perceptions towards Kibale remains untested.

Third, different approaches to promote conservation operate at different temporal scales. In our opinion, one important benefit of the field station is that it encouraged the development of other conservation programs. This was achieved as the field station provided a base for long-term research and promoted interaction with the local community and UWA. Several conservation programs arose from the field station, each operating on different spatial and temporal scales, with some operating only near the field station (e.g., Kibale Health Clinic) and others operating park-wide (e.g., Kasiisi Project, Kibale Mobile Clinic), some potentially influencing park-people relationships rapidly (e.g., health care), and others having an effect from the immediate to very long term (e.g. education).

Fourth, the employment opportunities arising from a field station have the potential of reinforcing the 'rich get richer' phenomenon as jobs in the field station

are mostly offered to educated people. To mitigate the problem, careful steps should be taken to ensure that a wide spectrum of jobs are available and secondary education initiatives need to be launched. Otherwise, only the educated people get the jobs (and loans from the researchers) who in-turn can afford to educate their children, afford healthcare, and get a better quality of life, thus, further marginalising the poor. At the field station, initiatives such as the Kasiisi Project and Kibale Health Clinic have been instrumental at dispersing the secondary benefits of the research station to the larger community. Thus, evaluating the success of conservation projects also needs to encompass associated secondary projects that affect the larger community.

Finally, the goal of all conservation schemes is to protect biodiversity, thus planners should assess biodiversity and community perceptions before and after their implementation. There is evidence that the field station is protecting biodiversity by deterring poaching. Researchers have initiated programs for patrolling and snare removal in addition to programs that improve people-park relations through the provision of health services and education. In addition, long-term mammal research indicate population increases in a number of species.

Field stations have the potential to fill important conservation roles. Research stations advance scientific understanding, protect biodiversity, and can facilitate community welfare, involvement and development, even in the absence of ecotourism attractions. The multi-faceted benefits from the field station indicate that development agencies should consider investing in research stations, and governments should consider facilitating the establishment of research stations in collaboration with universities as part of conservation and community outreach mandates.

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Tables

Table 1: Descriptive information about the staff and some conservation initiatives in MUBFS (Struhsaker 1997, updated in this study)

<table>
<tr><td>Founded in</td><td colspan="2">1970</td></tr>
<tr><td>Founded by</td><td colspan="2">Dr. Thomas Struhsaker</td></tr>
<tr><td>Maintained by</td><td colspan="2">Makerere University since 1987</td></tr>
<tr><td rowspan="2">Number of employees (excluding Field Assistants)</td><td>Men: 39</td><td>Women: 13</td></tr>
<tr><td colspan="2">Total: 52</td></tr>
<tr><td>Number of employees from nearby villages (Excluding Field Assistants)</td><td colspan="2">Total: 41</td></tr>
<tr><td rowspan="8">Conservation, health and education related projects conducted using MUBFS as its original base and initiated by researchers at the field station,</td><td colspan="2">Kibale Health and Conservation Centre Conservation Centre (Health)</td></tr>
<tr><td colspan="2">Mobile Health Clinic (Health)</td></tr>
<tr><td colspan="2">The Kasiisi Project (Education)</td></tr>
<tr><td colspan="2">Kibale Snare Removal Program (KSRP) (Conservation)</td></tr>
<tr><td colspan="2">Herbarium (Education)</td></tr>
<tr><td colspan="2">Kibale Fuel Wood Project (Conservation)</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Long-term research projects at MUBFS	Kibale Chimpanzee Project
	Kibale Monkey Project
	Kibale Fish Project
	Kibale EcoHealth Project
	Primate Ecology and Nutrition Project

Table 2: Demographic information obtained through the survey.

	Tier 1	**Tier 2**	**Tier 3**	**Tier 4**	**Tier 5**	**Tier 6**	**Tier 7**	**CR**
Number of respondents	70	118	8	5	5	2	1	27
Average household size	4.97	4.34	3.25	5.4	3.2	6	3	4.85
Percentage of adults who have completed primary but not secondary education	13.97	9.25	15.62	0	0	0	0	9.92
Percentage of adults who	21.87	4.15	9.37	5	0	0	0	4.58

have completed secondary education								
Average number of livestock (Cow, Goat, Pig, Chicken) per household	8.66	5	5.87	6	5	9	9	5
% of households with Eucalyptus plantations	55.71	29.66	12.5	0	0	0	0	29.63
% of households with Cash Crop (Tea, Coffee, Sugarcane) plantations	28.57	9.32	12.5	0	20	0	0	14.81

Figure Captions

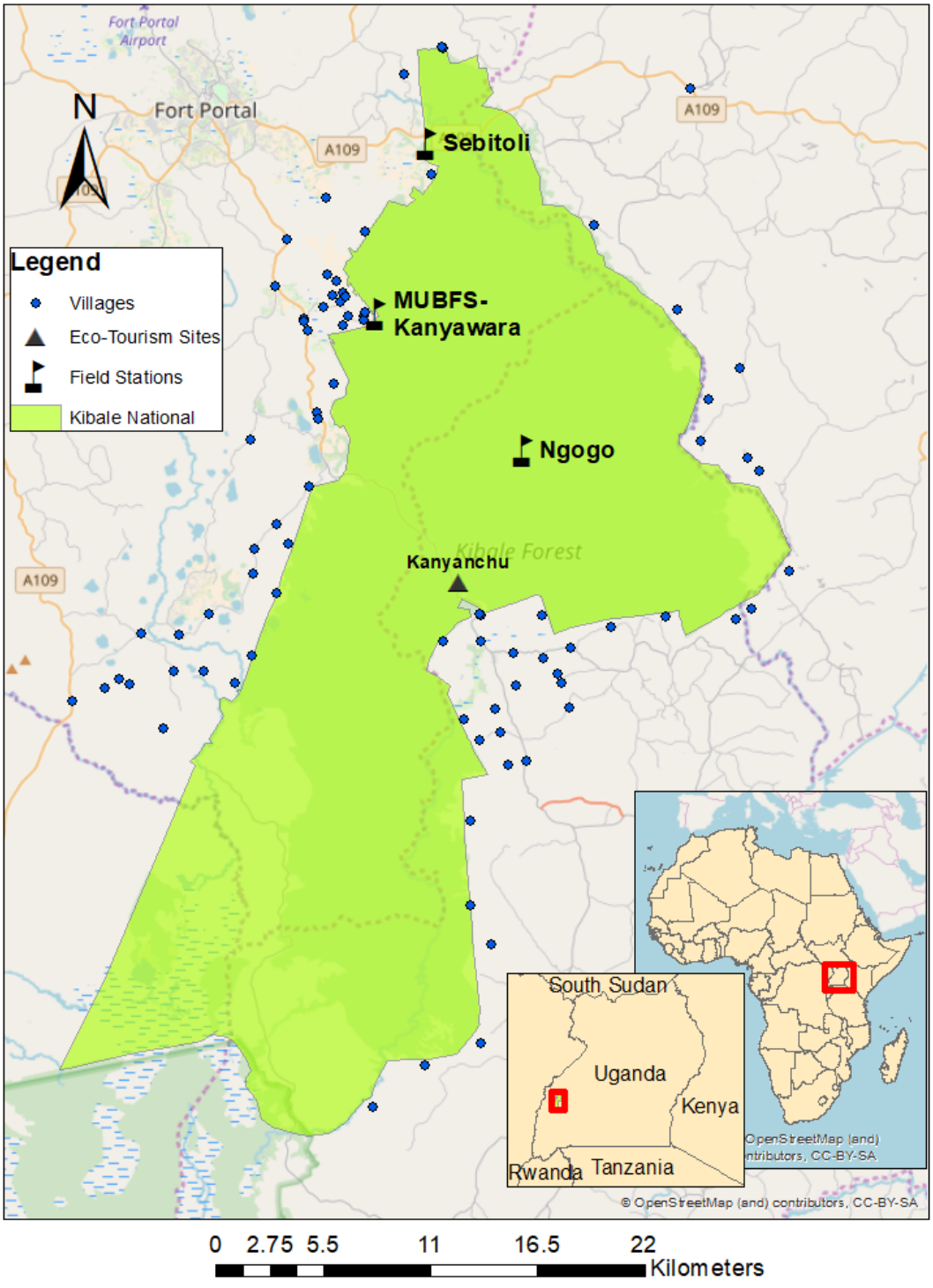
Figure 1: Map showing Kibale National Park, Uganda, villages around the park, the research field sites and the eco-tourism site at Kanyanchu

Figure 2: Number of people hired by employees of Makerere University Biological Field Station in Kibale National Park, Uganda according to their position at the field station. The thick solid line shows the sample mean along with thick dashed 95 percent confidence interval. Also displayed, as typical in whisker box plots is the median, the first and third quartile, and the maximum and minimum values.

Figure 3: Map showing location of Tier 1, Tier 2 and Control Respondents of the survey conducted adjacent to the Makerere University Biological Field Station in Kibale National Park, Uganda.

Figure 4: Inverse Distance Weighted surface showing predicted number of Tier 2 jobs within 5 km of Kibale National Park, Uganda.

Figures



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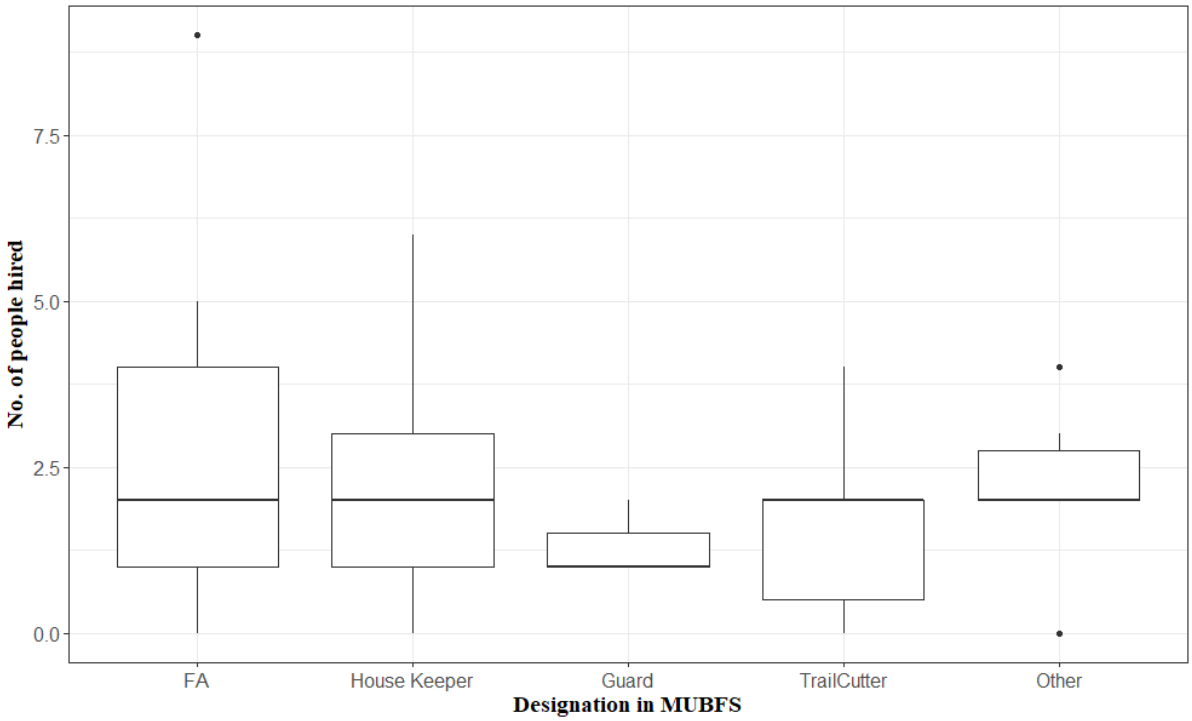

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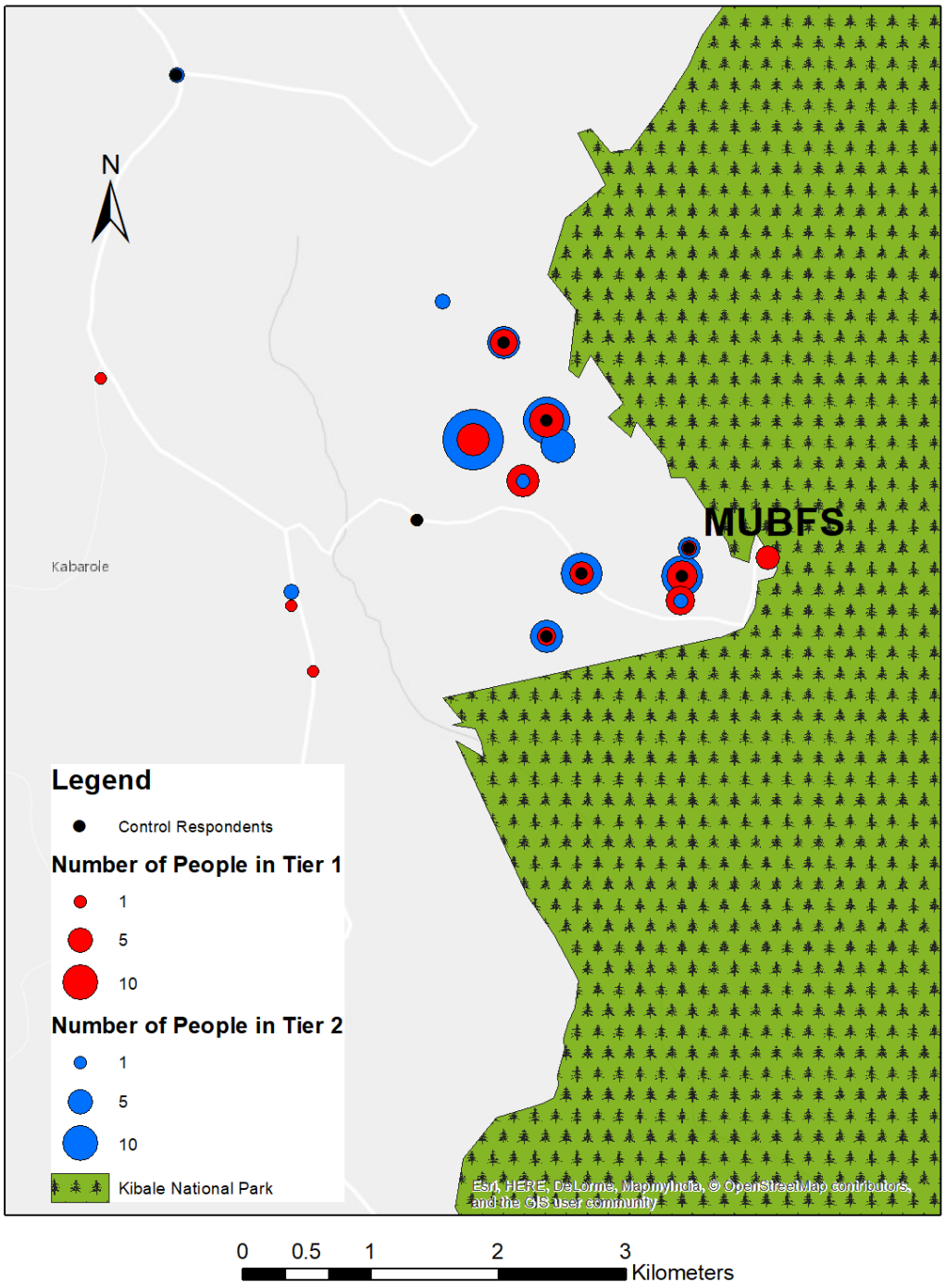

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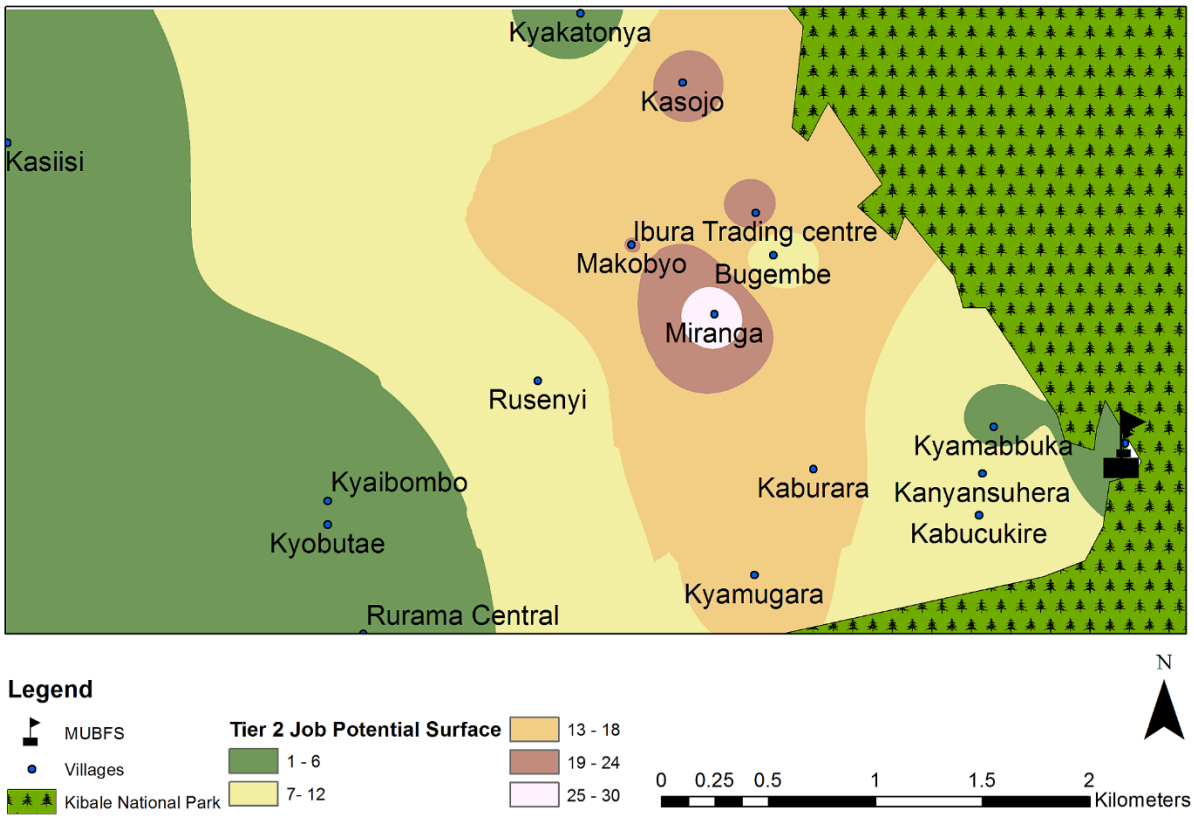

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