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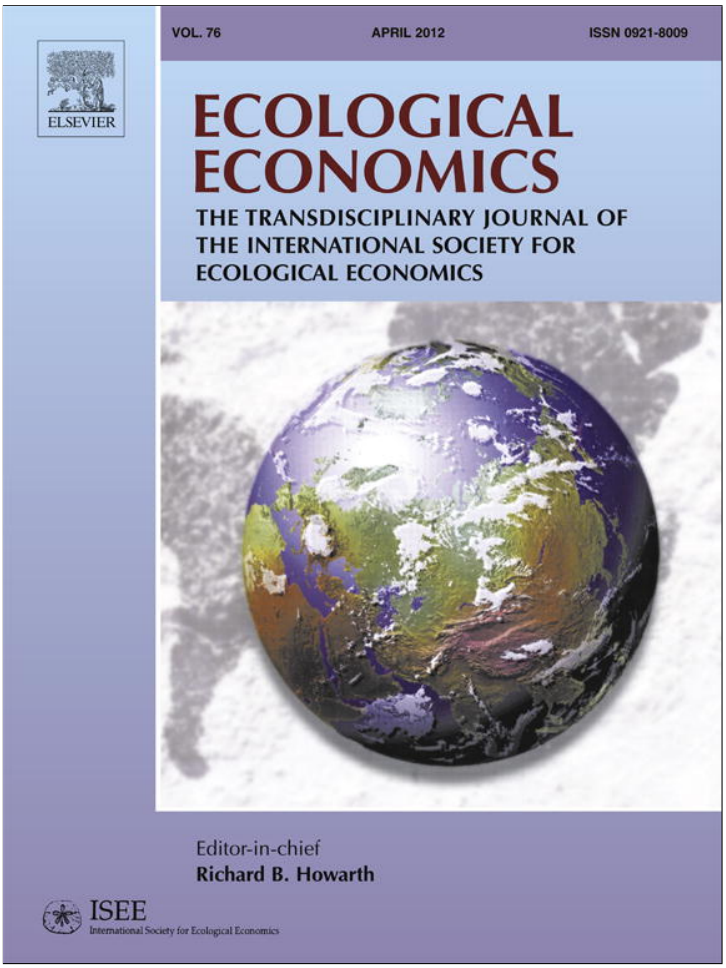

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Analysis

Accruing benefit or loss from a protected area: Location matters

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ABSTRACT

The spatial distribution of protected area direct benefits and losses were mapped for twenty-five villages around Kibale National Park, Uganda. Benefits included park-based employment, tourism revenue sharing, integrated conservation and development projects, and resource access agreements. Losses were caused by park-protected animals raiding crops and preying on livestock. Local perceptions of benefit and loss associated with the park were collected from focus groups and a household survey. Valuation data were derived from interviews, the survey, and measurement of crop losses. Eight villages accrued an annual net benefit as a result of the park, while 17 villages accrued a net loss. Net benefitting villages were located near park-based employment and resource access associations involved in beekeeping. Households within 0.5 km of the park boundary accrued the highest losses, while benefits distributed up to 15 km away. The Ugandan Wildlife Authority (UWA) needs to focus benefits closer to the park boundary to support those who lose most from park-protected animals, and away from areas with park-based employment to more evenly distribute benefits around the circumference of the park. Attitudes toward the park appear to be shaped by loss aversion, suggesting UWA and conservation agencies should focus on loss mitigation, rather than benefit provision.

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1. Introduction

Protected area (PA) benefits tend to accrue globally, while PA creation results in a complex web of gains and losses for local people (Adams and Hutton, 2007; West et al., 2006). Recreation opportunity, existence and bequest value (Tisdell, 2005), and the utility of forested PAs to sequester carbon (Grieg-Gran and Bann, 2003; Naughton-Treves et al., 2005) are most often realized by people in developed countries. Communities situated on the boundaries of PAs disproportionately assume the costs of conservation (Ninan et al., 2007; Nyhus et al., 2005), as a result of eviction (Brockington and Igoe, 2006), crop and livestock raiding by park-protected animals (Naughton-Treves and Treves, 2005; Nyhus et al., 2000), and exclusion from resources (Ferraro, 2002). However, local people may also benefit from PAs through the preservation of ecosystem services (Millennium Ecosystem Assessment, 2005), tourism (Archibald and Naughton-Treves, 2001), non-governmental organization (NGOs) integrated conservation and development programs (ICDPs; Barrett and Arcese, 1995), and through resources access agreements (Chhetri et al., 2003).

Exchange theory dictates that rational humans base their behavioral choices on maximizing gains and minimizing costs (Shogren et al., 1999), implying that if local people benefit from the existence of a PA, they will support conservation and the continued existence of the PA. Therefore it has been proposed that material benefits can offset accrued costs, making conservation economically beneficial to communities near PAs (Ferraro and Kiss, 2002; McNeely, 1988), while limiting negative consequences for local livelihoods (Adams et al., 2004).

Assessment of the influence of benefits has been cautiously optimistic (Archibald and Naughton-Treves, 2001; Spiteri and Nepal, 2008); although recognition of benefits can be limited and may not sufficiently accrue to those carrying the greatest conservation costs. A number of studies on the negative influences of PA creation (Brockington and Igoe, 2006; Brockington et al., 2006; Naughton-Treves and Treves, 2005), have focused on eviction, exclusion, and crop raiding. Balanced assessments of the benefits and losses accrued by local communities have been reported by Dixon and Sherman (1991) and Spiteri and Nepal (2008), but in general there is a dearth of research upon which to base the development of conservation incentives that will protect biodiversity and minimize negative externalities assumed by local communities (Brockington et al., 2008; Igoe, 2006; Wilkie et al., 2006).

In south western Uganda, PAs have been created to protect critically endangered gorillas *(Gorilla beringei)* and chimpanzees *(Pan troglodytes)* (Plumptre, et al., 2003). Conservation policy is defined through national legislation (Uganda Wildlife Statute, 1996), and managed by the Uganda Wildlife Authority (UWA). Although Ugandan policy is dependent upon enforcement of park boundaries, UWA has been moving towards a more participatory strategy since the mid 1990s, as evidenced by their mission statement: "To conserve and sustainably manage the wildlife and protected areas of Uganda in partnership with the neighboring communities and other stakeholders for the benefit of the people of Uganda and the global community" (UWA, 2002, 4). UWA manages PAs using a 'Park and Neighbor' strategy (Jones, 2006), including seven specific

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components: 1) strict monitoring and boundary enforcement, 2) forest restoration and carbon sequestration (FACE the Future, 2011), 3) conservation research, 4) community and education outreach, 5) negotiated resource access agreements (Chhetri et al., 2003), 6) encouraging tourism, and 7) sharing 20% of park entrance fees with local communities (Archibald and Naughton-Treves, 2001).

Kibale National Park (KNP) provides protected habitat for the largest population of chimpanzees in East Africa (Plumptre et al., 2003). Revenue sharing and resource access agreements have been studied around KNP (Archibald and Naughton-Treves, 2001; Chhetri et al., 2003), but given the naicent state of these strategies at the time, minimal information on financial value was available. Loss valuation for crop raiding has also been documented for KNP (Naughton-Treves and Treves, 2005), but no systematic comparison of all direct benefits and losses accrued by local communities as a result of the existence of KNP has been done to determine if conservation is having a positive or negative influence on local livelihoods. Using an economic geography perspective, this paper expands on the value of UWA conservation strategies to local communities around KNP, assessing benefits provided through UWA, park-based employment and NGOs from 1999 to 2009, to determine if the spatial distribution of benefits equitably addresses direct losses incurred by local residents as a result of crop raiding and predation by park-protected animals, and UWA fines for illegal park entry.

2. Methods

2.1. Study Site

KNP is a 795 km^2 mixed forest and savannah grassland PA in southwestern Uganda (Fig. 1). The park provides protected habitat to chimpanzees, 12 other primate species, elephants (*Loxodonta africana*), and a high level of biodiversity in other taxa (Chapman and Lambert, 2000).

Resource access inside the area that is now KNP has been restricted throughout the area's recorded history. In the 1800s, the tribal Toro king placed restrictions on hunting that were further tightened by the British colonial government in the early 1900s (Naughton-Treves, 1999). The post-colonial government maintained the forest reserves and game corridors set-up by the British, however these reserves were overrun and settled during the 1971–1987 civil war (Hamilton, 1984). Following the war, the Ugandan government reclaimed Kibale forest reserve and game corridor, evicting all settlers (Feeney, 1998). Those evicted were settled far from the park, and only 2% of current residents near KNP report being evicted (Hartter and Goldman, 2010). KNP was established as a national park in 1993, and people continued to be excluded from the park except for negotiated access to non-threatened resources (Chhetri et al., 2003).

Since the area had restricted use since the 1800s, and 56% of households had migrated to the borders of KNP within the last generation (MacKenzie and Hartter, in press), it can be argued that a majority of local residents never could lay claim to land inside the park. Therefore opportunity costs associated with the inability to cultivate the park are not a valid cost accrual. Lost access to park resources is also not a valid cost accrual because access restrictions on hunting, firewood and construction pole collection, and in-park grazing have existed since the park was a forest reserve. Local residents do illegally extract resources from the park (Mackenzie et al., 2012), and this appears to alleviate extreme poverty close to the park relative to communities farther away (Naughton-Treves et al., 2011). However if the park were not protected, resource extraction would be higher based on rapid loss of tree cover outside the park (Hartter and Southworth, 2009), and growing demand for resources from rural and urban markets (Mackenzie and Hartter, in press). Since this study analyses only direct benefits and losses associated with living next to KNP, and lost access costs are debatably not relevant in the context of KNP, opportunity costs have not been accounted.

African rural communities are heterogeneous (Agrawal and Gibson, 1999), and benefits and losses differentially accrue among households (Brockington et al., 2008). However, the valued benefits and losses presented in this paper are accounted at the village-scale for two reasons: revenue sharing and many NGO projects are provided at the village scale, and to capture a broader geographic perspective of the spatial distribution of benefit and loss accrual around the park.

A village is defined by the spatial extent of households associated with a village name under the leadership of one village chairperson. Twenty-five villages, located directly adjacent to the park, were purposely chosen based on achieving an even spatial distribution of villages within the data collection zone (Fig. 1), while including villages that did and did not benefit from revenue sharing, park-based employment, and

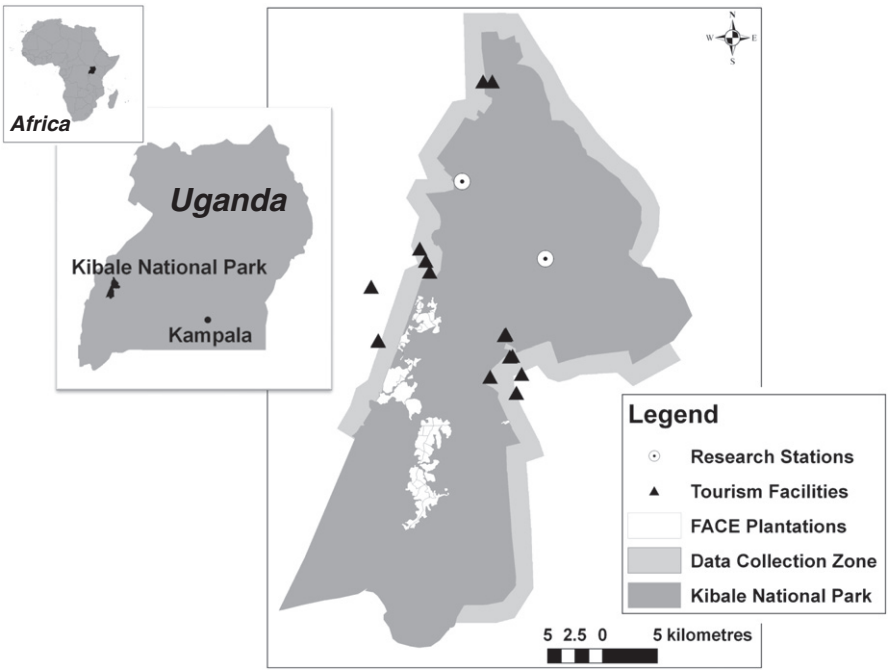

Fig. 1. Map of Kibale National Park, Uganda and data collection zone.

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negotiated resource access. Households within villages were located up to 3 km from the park boundary. Study villages were approximately five kilometers apart, but are not explicitly identified, since an illegal resource extraction study was also conducted in these villages (MacKenzie et al., 2012), and identification of where that data was collected might lead to retribution from the wildlife authority (Robbins et al., 2006). Inverse distance weighted interpolation to rasterize data to a 1,000 m grid, followed by re-sampling to a resolution of 30 m within the data collection zone has been used to visualize village-level data.

2.2. Data Collection

2.2.1. Focus Groups

To understand the problems and benefits of living next to KNP, focus groups were conducted in 15 villages (60%) in June and July 2008. As per local custom, the village chairperson approved and helped organize the focus groups, inviting 20 village residents, both male and female, ranging in age to represent the adult population in the village. However, since the only location for meetings was under a tree in the middle of the village, attendance often grew beyond those invited. Since focus groups were held at the beginning of the study, I did not want to insult potential future participants, and allowed additional people to join the meetings. As a result, the number of participants ranged from 16 to 51, with women representing up to 65% of participants. Larger meetings took more time, so all who wished to contribute had an opportunity to speak. Discussion was facilitated by a Ugandan assistant in local tribal languages, translating responses verbally during the meeting, while I took notes. Since villagers would not allow themselves to be recorded, another assistant wrote all he heard from the villagers, allowing triangulation of our notes for a more complete record of the meeting. The meeting facilitator created a good rapport with male and female participants, asking women for their opinions if they did not initially speak up. Focus group participants were asked to list all problems of living next to the park and then all benefits. At the end of the meeting we asked if the disadvantages of living near the park were offset by the benefits.

2.2.2. Household Survey

In July and August 2009, a household survey was conducted in all 25 villages. Within each village 23 to 25 households were surveyed.[1] A total of 596 surveys were collected, representing 24% of all households in the 25 villages, with a median of 28.6% of households surveyed per village. Households were chosen by random stratified sampling, with stratification based on house construction standard (Ellis and Bahiigwa, 2003), a proxy for household wealth. The survey was administered by four Ugandan field assistants, in the two local languages (Rutooro and Rukiga).

Survey respondents were asked to rate their perceived benefit or loss of living next to the park on a five-point Likert scale ranging from no benefit or loss (1) to a lot of benefit or loss (5). They were asked to rate, on the same scale, their perceived benefit of park-based employment, revenue sharing, NGO activities, ecosystem services, and resource access agreements. Similarly, they were asked to rate perceived loss related to crop raiding, predation, and UWA arrests and fines for being illegally in the park. They were also asked to describe specific benefits their household or village had received, and to estimate the number and type of domestic animals lost to predation, and the number of times members of their household had been arrested or fined by UWA.

2.2.3. Crop Raiding Study

Crop raiding was the largest loss, and since people tend to overestimate losses due to crop raiding in the hopes of receiving compensation (Tchamba, 1996), data were collected to verify the damage incurred. The type of crop and area damaged by park-protected animals was recorded weekly for six households in each village from August 2009 to January 2010.

2.2.4. Interviews

Interviews were conducted from May 2008 to January 2010 with UWA wardens, district, sub-county and village chairpersons, resource access agreement (RAA) association chairpersons, and managers of tourist facilities, research operations, NGOs and the carbon offset project (FACE the Future, 2011). Enterprises providing park-based employment (tourism, research, FACE, and UWA) were asked about the number of employees, average pay rate, and to identify the home village of employees. UWA and chairpersons were asked to summarize their experience with the revenue sharing program and to state the money distributed or received from 1999 to 2009. RAA chairpersons were asked to describe their agreement with UWA, the number of association members and their home villages, and to estimate the value or resource yield of the agreement for the average association member. NGO managers were asked to describe the benefits they provided, which villages they worked in, to summarize the financial investment made, and the timeframe they had been active around KNP.

2.3. Analysis

2.3.1. Perceived Benefit and Loss

Radial distributions of benefit or loss were the percent of households within each of the 250 m buffers extending outward from the park boundary, where the respondent reported a benefit or loss rating >1 (greater than no benefit or loss). Circumferential distributions of benefit or loss were the percent of households within each village reporting a benefit or loss rating >1. Village-mean perceived benefit was the average of all survey respondent perceived benefit ratings in that village; similarly for loss.

2.3.2. Valuation

Benefits and losses accrued at four different scales: groups of villages, village, groups of households, and individual households. In order to use the most reliable valuation data, benefits and losses were valued at the scale they accrued, and then aggregated or disaggregated to the study villages.

Revenue sharing and NGO benefits were typically accrued by more than one village. The project value was assigned to each study village based on use. For example, schools service multiple villages, so the value of a school project to a study village was apportioned based on the ratio of study village students enrolled in the school and the total school enrolment. Alternatively, if the project was a revenue sharing elephant trench built between a village and the park to stop elephants from destroying village crops, then the full cost of the trench was assigned to that village. With the exception of school-based NGOs, the average annual budget for each NGO was divided between all villages where the NGO was active.

RAA value accrued to a group of association member households within a village. The village-value of RAAs was calculated as the number of people who were members of an RAA association in the village (typically three to 30), multiplied by the average value of the RAA per member. Beekeeping RAA valuation was calculated as the mean volume of honey produced by each association member per year, multiplied by the local market price of honey. Craft RAA valuation was based on their mean earnings from craft sales per year. Agreements for exotic tree extraction specified the number of trees authorized for harvest, so value was equal to the number of trees multiplied by the local market price for the timber from one tree. Only one study village had members in a fishing association but had not yet started fishing, and therefore no value was assigned.

Park-based employment is accrued by the household, and since employers provided employment records, the village-value was

[1] The number of households in a village ranged from 41 to 242, median = 84.

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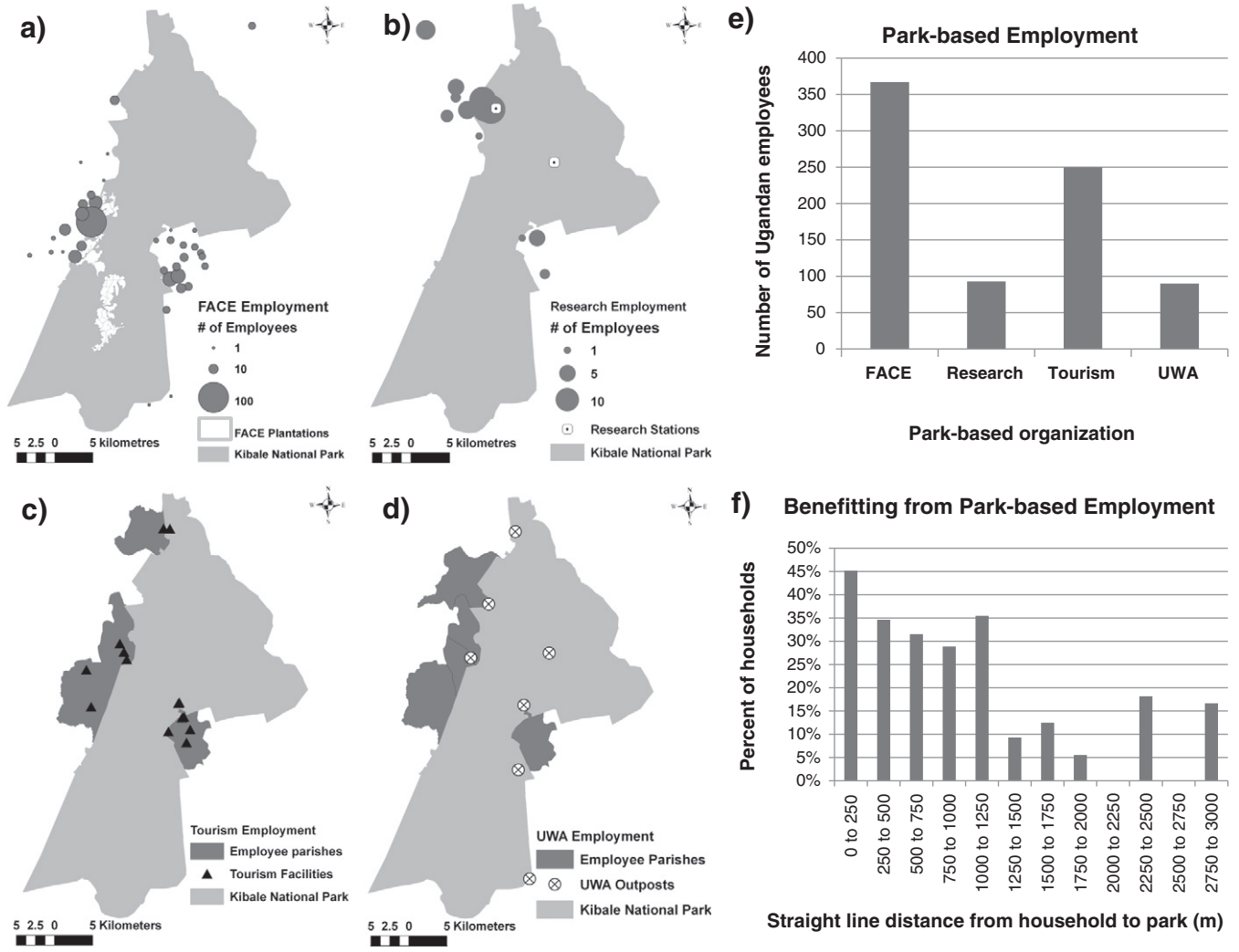

Fig. 2. Spatial distribution of park-based employment around Kibale National Park, Uganda. a) Distribution of carbon-sequestration employees, b) Distribution of research employees, c) Areas of tourism employment, d) Areas of UWA employment, e) Number of employees by park-based employer, and f) Radial distribution of households reporting benefit from park-based employment.

calculated by multiplying the number of people employed by an enterprise in a village by the average salary paid by that enterprise. The employment rate of study village adults was 22%, of which 52% were employed as farm laborers, 23% by tea plantations, 13% by park-based enterprises, and 12% in numerous other occupations. Given the lack of alternative employment, the full value of park-based employment was accounted as a park-based benefit.

Crop raiding and predation losses also accrue to the household, and are experienced by a majority of study village households. Since nominal valuation for each household was impractical, village-scale crop raiding and predation losses were calculated by multiplying the mean household loss in each village by the relative number of village households reporting these losses in the survey. The village-mean value of predation loss was based on the household survey reported number of cows, goats, sheep, pigs and chickens lost to wild animals, multiplied by the market value of each domestic animal. The village-mean value of crop raiding loss was based on losses from the six crop raiding study households, calculated as the local market value of the crop/m^2 multiplied by the area damaged.

UWA fines also accrued to households and had to be based on ratio survey data, as UWA records were incomplete (UWA official, personal communication). All monetary benefits and losses were annualized and the exchange rate to convert from Uganda Shillings to US Dollars was dependent upon the timeframe over which the benefit or loss was accrued.[2]

Typically, comparisons of benefits and losses for a given venture are assessed in a Cost-Benefit Analysis (CBA), and require that all past and future benefits and losses accrued by all stakeholders in the venture be accounted, either through direct financial costs or via contingent valuation assessed as a willingness to pay to get the benefit, or to prevent the loss (Pierce, 1998). The analysis presented in this paper is not a CBA because: benefits and losses are valued over the period 1999 to 2009 with no future values estimated, there is no contingent valuation of incommensurables, such as ecosystem services or existence value of protected species, and no account has been taken of the benefits or losses accrued by UWA, local government, or the global conservation community. Although the data included in this paper could support a broader CBA, the objective of this paper is to assess only benefits provided through the UWA conservation strategy and NGOs to determine if

[2] Park-based employment and crop raiding loss used the mean exchange rate for August 2009 to February 2010 = 2250 Ugandan shillings/US$, revenue sharing used the mean exchange rate from 1999 to 2008 = 1600 Ugandan shillings/US$. NGO activities were active around KNP from 1998 to 2009 and benefits were converted using an exchange rate of 1681 Ugandan shillings/US$. Predation losses and UWA fines collected in the survey referenced a 10 year period prior to the survey (July 1999 to July 2009) and used a mean exchange rate of 1772 Ugandan shillings/US$.

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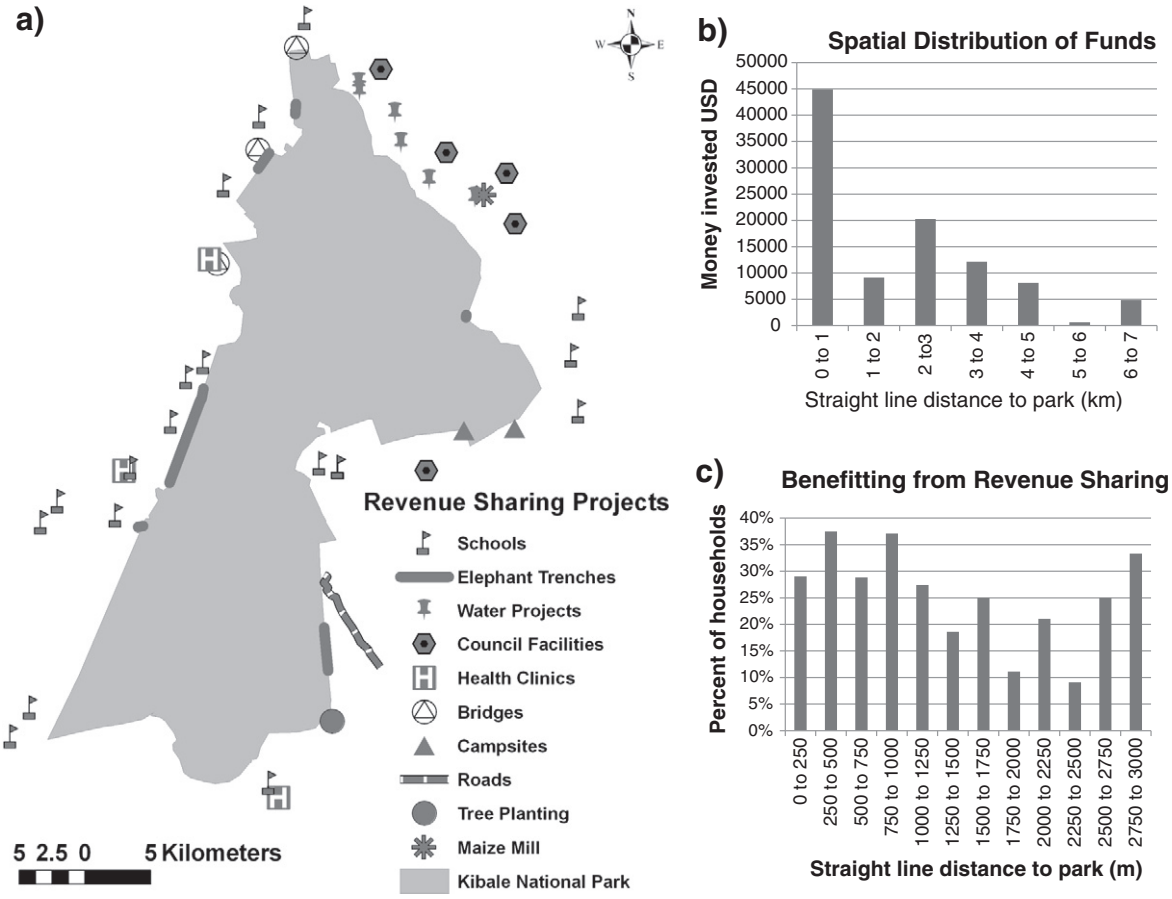

Fig. 3. Spatial distribution of revenue sharing around Kibale National Park, Uganda. a) Map of revenue sharing project locations, b) Radial distribution of fund investment, and c) Radial distribution of households reporting benefit from revenue sharing.

their spatial distribution equitably addresses the direct costs identified by local villagers.

2.3.3. Statistical Analysis

The distribution of study variables were compared with a normal distribution using a Kolmogorov-Smirnov test. All village-scale variables were normally distributed with the exception of park-based employment value, and RAA value. Household-scale variables were not normally distributed. Pearson correlations and t-tests were used if variables were normally distributed; if not normally distributed, a Spearman correlation or Mann–Whitney test was used.

3. Results

3.1. Benefits and Problems Self-identified by Residents

All 15 focus groups (FGs) identified crop raiding by park-protected animals as the biggest problem of living next to KNP, as did 73% of household survey respondents (HSRs). Some participants said their family went hungry after crops were raided (6 FGs, 71% HSRs). Discussion about crop raiding was prolonged and heated, with people in 11 FGs insisting on loss compensation. In nine FGs, UWA was criticized for not coming to the aid of local people, especially when elephants raided. In seven meetings people explained they had to chose between their children's education or having food to eat, because they had to keep their children home to guard crops (39% HSRs).

The second problem identified by FG participants was being arrested and fined by UWA (12 FGs, but only 6% HSRs). In one meeting participants thought UWA was mistaken about the location of the boundary. In eight FGs people stated they were unable to get the resources they wanted from the park because of the risk of meeting UWA (79% HSRs).

Participants thought they suffered more illness because they lived close to the park (11 FGs, 95% HSRs), and that they lacked infrastructure near the park, citing bad roads (3 FGs, 84% HSRs), long distances to schools and hospitals (2 FGs, 66% HSRs), and lack of clean water access (2 FGs, 67% HSRs). During times of political instability rebels hid inside the park, harassing local residents. Even though these attacks stopped by 2000, people still highlighted this as a problem of living next to KNP (4 FGs, 41% HSRs). Livestock predation (2 FGs, 65% HSRs) and the risk of personal injury from wild animals (2 FGs, 23% HSRs) were also identified as problems of living near the park.

Three of these problems were valued for the geographical distribution analysis: crop raiding, fines issued by UWA, and livestock predation. Data on disease prevalence as a function of distance from the park was not available, although health researchers are now embarking on studies to determine if the perceptions of these villagers are correct. Poor infrastructure is a problem in most rural communities in western Uganda, and therefore is not related to the existence of KNP. Rebel incursions occurred before the valuation timeframe of this study, 1999 to 2009. The impact of wild animal attacks ranged from severe physical injury, one man had lost the use of one hand after a baboon attack, to psychological distress, “people are scared of elephants so cannot harvest crops”. Given the wide range of personal injury outcomes, financial valuation of these attacks was beyond the scope of this study.

FG participants spent a lot of time discussing the problems they encountered due to the park, but were less enthusiastic about benefits. When asked to compare park-based benefits with park-based losses, all FGs agreed that the problems of living near KNP were much bigger than the benefits. Eighty-two percent of HSRs reported their household lost

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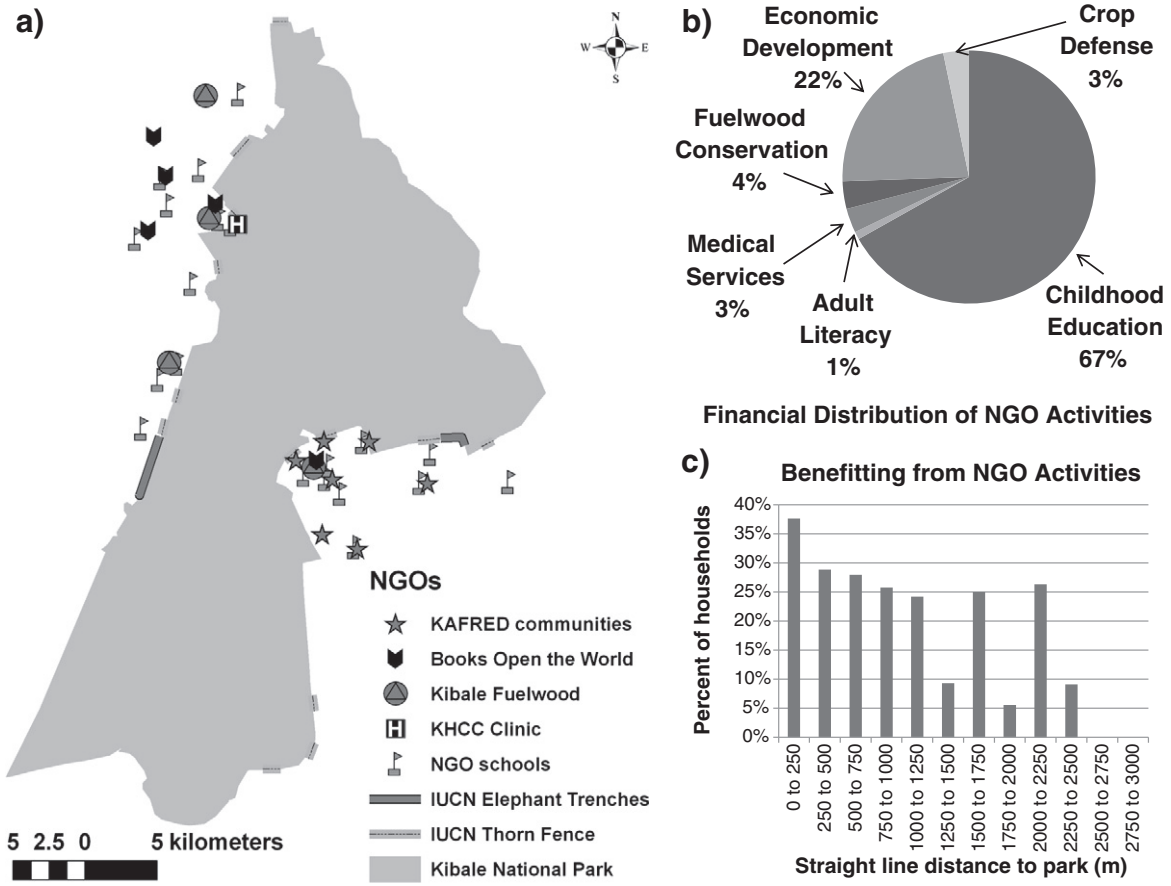

Fig. 4. Spatial distribution of NGO activities around Kibale National Park, Uganda. a) Map of NGO locations, b) Financial distribution of NGO investments, and c) Radial distribution of households reporting benefit from NGO activities.

due to living next to the park, on average rating that loss between 'some' and 'considerable' (3.5). Seventy percent of HSRs reported they did benefit from living near the park, on average rating the benefit as 'little' (2.2).

Better rainfall and climate near the park were identified as benefits (11 FGs): "The trees keep it cooler and make more rain", "we no longer face serious drought because we are always showered with rainfall", and "other places are hotter and drier because they are away from the park". Ninety-seven percent of HSRs said they benefitted from more rainfall, and 94% said soil fertility was better closer to the park.

Projects funded through the revenue sharing program (8 FGs, 23% HSRs), or since some were unaware of the program, projects paid for by UWA (4 FGs, 13% HSRs), were identified as a benefit. Twelve of the FG villages and 16 of the household survey villages had received a revenue sharing project. Park-based employment (9 FGs, 19% HSRs) was also considered beneficial although in one meeting people complained that employment was going to better educated urban residents. Villagers said they benefited from agreements to legally extract resources from the park (4 FGs, 10% HSRs); with two FGs explaining they had higher honey yields because they could put hives inside the park. The benefit of NGO activities was only mentioned in three FGs, but HSRs stated they had received aid from an NGO (12%), benefits from foreigners (10%), had help to build an energy saving stove (10%), or had received a scholarship for their children (4%).

Park-based employment, revenue sharing, conservation-based NGO activities and resource access agreements are all benefits accrued as a result of the existence of the park and were valued. However, due to a lack of data on rainfall and soil fertility around and moving away from the park, and since contingent environmental valuation was not used, the benefit of ecosystem services was not valued.

3.2. Benefit Distribution

3.2.1. Park-based Employment

The FACE the Future Foundation is reforesting the areas cleared by evicted settlers. Seasonally, they employ up to 367 people, 96% of whom live close to the park (Fig. 2a). The Makerere University Biological Field Station (MUBFS) attracts domestic and foreign researchers who hire research assistants. In January 2010, long-term research projects employed 93 Ugandans, 91% from villages near the park (Fig. 2b). Habituated chimpanzees attract 7650 visitors annually (UWA, 2009), creating full and part-time employment in tourist facilities for over 250 people, 87% from near the park (Fig. 2c). UWA employs eight wardens, 54 rangers and 36 support staff. All support staff come from villages near the park (Fig. 2d), while wardens and many rangers come from other areas of Uganda. Park-based enterprises employ over 800 people (Fig. 2e), leading to annual salaries for residents surrounding KNP totaling US$570,839 (FACE US$132,463, Research US $127,176, Tourism US$271,200, UWA US$40,000). The value of park-based employment to study villages ranged from nothing to over US $27,000 per year. The percent of HSRs perceiving benefit from park-based employment was higher near the park boundary (Fig. 2f). Based on employment records, employees came from up to 15 km from the park.

3.2.2. Revenue Sharing Program

Revenue sharing has been law in Uganda since 1996, and requires 20% of park entrance fees be distributed for community projects in villages next to the park. From 1999 to 2009, 55 projects had been implemented with the US$150,000 distributed. Funds were allocated to complete significant projects, and therefore, not all villages bordering

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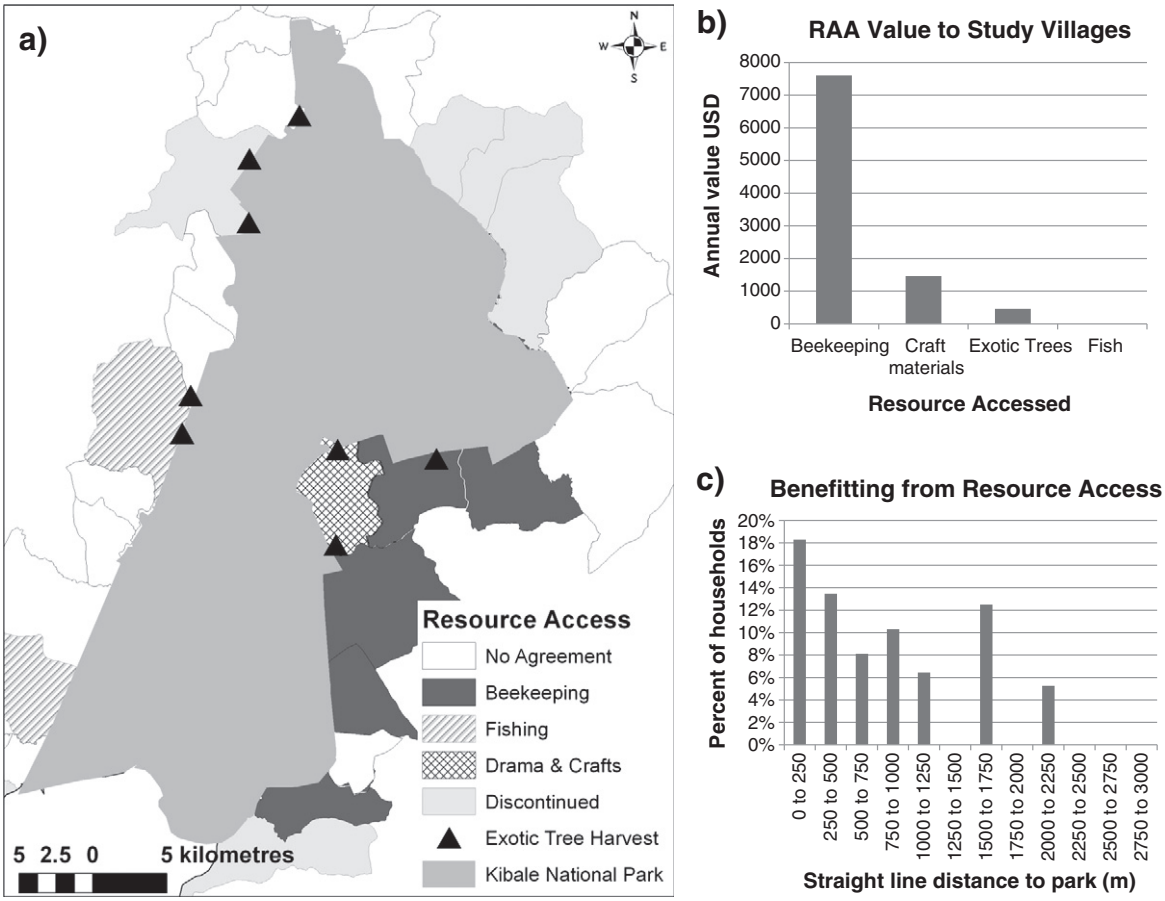

Fig. 5. Spatial distribution of resource access agreements around Kibale National Park, Uganda. a) Map of areas with resource access agreements, b) Resource access agreement value by resource, and c) Radial distribution of households reporting benefit from resource access agreements.

the park have as yet received a project. Initially, money was spent on schools, council facilities, and health clinics, but more recently is spent on crop raiding defenses and income generation projects. Local people prefer the money to be spent on crop defenses, considering schools and council facilities to be the responsibility of local government, not UWA (Mackenzie, in press). Projects are distributed around the park, within 7 km of the boundary (Fig. 3a), and the radial distribution of investment in completed projects shows the recent focus on building crop defenses on the park boundary (Fig. 3b). The financial benefit of revenue sharing to study villages ranged from nothing to US$457 per year. No consistent trend was identified in the radial distribution of HSRs identifying benefit from revenue sharing (Fig. 3c).

3.2.3. Non-governmental Organizations

Most NGOs around the park were initiated by researchers to help communities near their research locations: The Kasiisi project supports childhood education (Kasiisi Project, 2008), Books Open the World created libraries and supports literacy education (Books Open the World, 2007), Kibale Fuel Wood Project provides tree seedlings and teaches people to build energy saving stoves to conserve firewood (Kibale Fuel Wood Project, 2011), and the Kibale Health and Conservation Centre supports the medical needs of six communities (Kibale Health and Conservation Project, 2011). These NGO activities are independent of the research-based employment and have been separately accounted. ICDP projects have been initiated by the International Union for Conservation of Nature (IUCN) to develop crop raiding defenses and income generating opportunities (Chhetri et al., 2004), and by Uganda and North Carolina's International Teaching for the Environment program (UNITE) to improve conservation education in Ugandan primary schools (Uganda UNITE, 2007). The Kibale Association For Rural and Environmental Development (KAFRED) is a community-based conservation organization (Lepp and Holland, 2006), supporting development projects through community-based tourism. NGO activity is primarily clustered along the northwest and central eastern boundary (Fig. 4a). NGO investment from 1999 to 2009 totaled over US$1 million, primarily aimed at programs to improve childhood education (Fig. 4b). The annual financial value of NGO activities in study villages ranged from nothing to over US$4,800 per year.[3] The percent of households perceiving benefit from NGO activities was higher closer to KNP (Fig. 4c), although NGO activities extended up to 5.3 km from the park.

3.2.4. Resource Access Agreements

Community associations negotiate with UWA for access to non-threatened resources inside the park. In return for access, the association promises to report illegal activity inside the park, to not endanger park animals, and to help educate others about conservation (Chhetri et al., 2003). Current agreements permit keeping beehives, collecting craft materials, harvesting exotic tree species, and fishing in two lakes inside the park (Fig. 5a). In the past there were also agreements for firewood collection, watering cattle and picking wild coffee, discontinued due to resource exhaustion, non-compliance with park rules, or collapse of the association. Eight study villages had residents who were members of RAAs (MacKenzie et al., 2012). The financial value of RAAs to study villages primarily came from beekeeping agreements (Fig. 5b), and ranged from nothing to over US$2,500 per year. Households perceiving benefit from RAAs were clustered within 2.25 km of the park boundary (Fig. 5c).

[3] Valuation includes all NGOs except UNITE, for which financial data was not made available.

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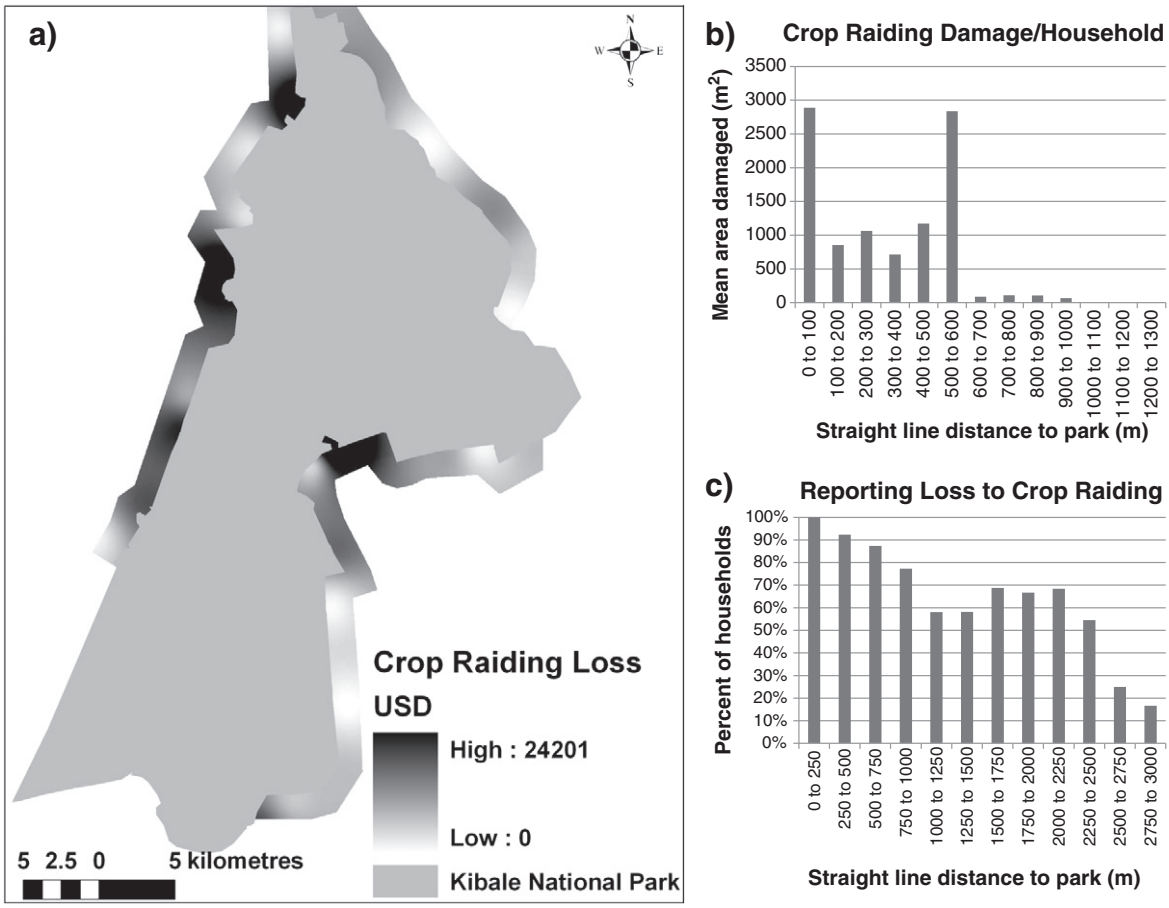

Fig. 6. Spatial distribution of crop raiding losses around Kibale National Park, Uganda a) Circumferential distribution of village-scale crop raiding loss, b) Radial distribution of area damaged by park-protected animals, and c) Radial distribution of households reporting loss from crop raiding.

3.2.5. Total Valued and Perceived Benefit

The summation of village-valued direct benefits ranged from nothing to US$28,460 per year; with the highest benefit accruing near park-based employment. The village-mean perceived benefit of living next to KNP was spatially associated with the village-valued total benefit ($r_{Pearson} = 0.540$, $p = 0.005$, $n = 25$), even though the valued benefit did not include ecosystem services.

3.3. Losses

3.3.1. Crop Raiding

The average crop raiding study farmer lost $148 per year to park-protected animals eating or damaging their crops (MacKenzie and Ahabyona, 2012). Losses to crop raiding were not uniform (Fig. 6a), and were higher in villages suffering elephant raiding. Ninety-four percent of crop raiding damage was caused by baboons (*Papio cynocephalus*) and elephants; baboons were more frequent raiders but elephants damaged more area per visit. During the six month crop raiding study, 90% of damage occurred within 530 m of the park boundary (Fig. 6b). The percent of survey households reporting crop raiding loss was higher closer to the park boundary (Fig. 6c). The village-valued loss to crop raiding ranged from nothing to over US$24,000 per year. This loss may be understated, because 39% of survey households had changed their crop planting practices, and 65% of households invested labor to guard crops, to try to minimize crop losses.

3.3.2. Predation

Survey respondents reported their livestock had been predated by lion (*Panthera leo*, 3% HSRs), leopard (*Panthera pardus*, 4% HSRs), serval cat (*Felis serval*, 49% HSRs), civet cat (*Civettictis civetta*, 4% HSRs), hyena (*Crocuta crocuta*, 1% HSRs), jackel (*Canis adustus*, 6% HSRs), baboon (11% HSRs), and mongoose[4] (*Herpestidae* spp., 62% HSRs). Chickens represented 71% of the valued loss, with goats (13%), cows (7%), pigs (5%), and sheep (2%) making up the balance. Some villages were more prone to predation than others (Fig. 7a), although the cause of this variation was not investigated. The average household had lost $16 per year to predation. Losses were higher in households with more livestock ($r_{Spearman} = 0.238$, $p < 0.001$, $n = 594$), making the radial distribution of loss (Fig. 7b), and percent of households reporting predation loss (Fig. 7c), less distinct. The village-valued loss to predation ranged from US$426 to US$9,154 per year.

3.3.3. UWA Fines

Only 4.7% of survey households had had a household member arrested by UWA, and only 6.4% had been fined by rangers for being in the park illegally. Reported fines ranged from US$5 for collecting firewood to US$100 for grazing livestock. The valued loss to UWA fines per village ranged from nothing to US$140 per year.

3.3.4. Total Valued and Perceived Loss

The village-valued total loss ranged from just over US$1,000 per year to over US$25,000 per year. The village-mean perceived loss of living next to KNP did not correlate with valued loss ($r_{Pearson} = 0.134$, $p = 0.522$, $n = 25$). Household loss ratings tended to be high, with any loss considered to be a major burden. Even though opportunity costs of lost resource access were argued in Section 2.1 as invalid, 53% of FGs and 79% of HSRs identified loss of access to resources as a problem

[4] Mongoose is a common predator in Uganda, however, households were more likely to report mongoose predation closer to the park (Mann-Whitney $p = 0.022$)

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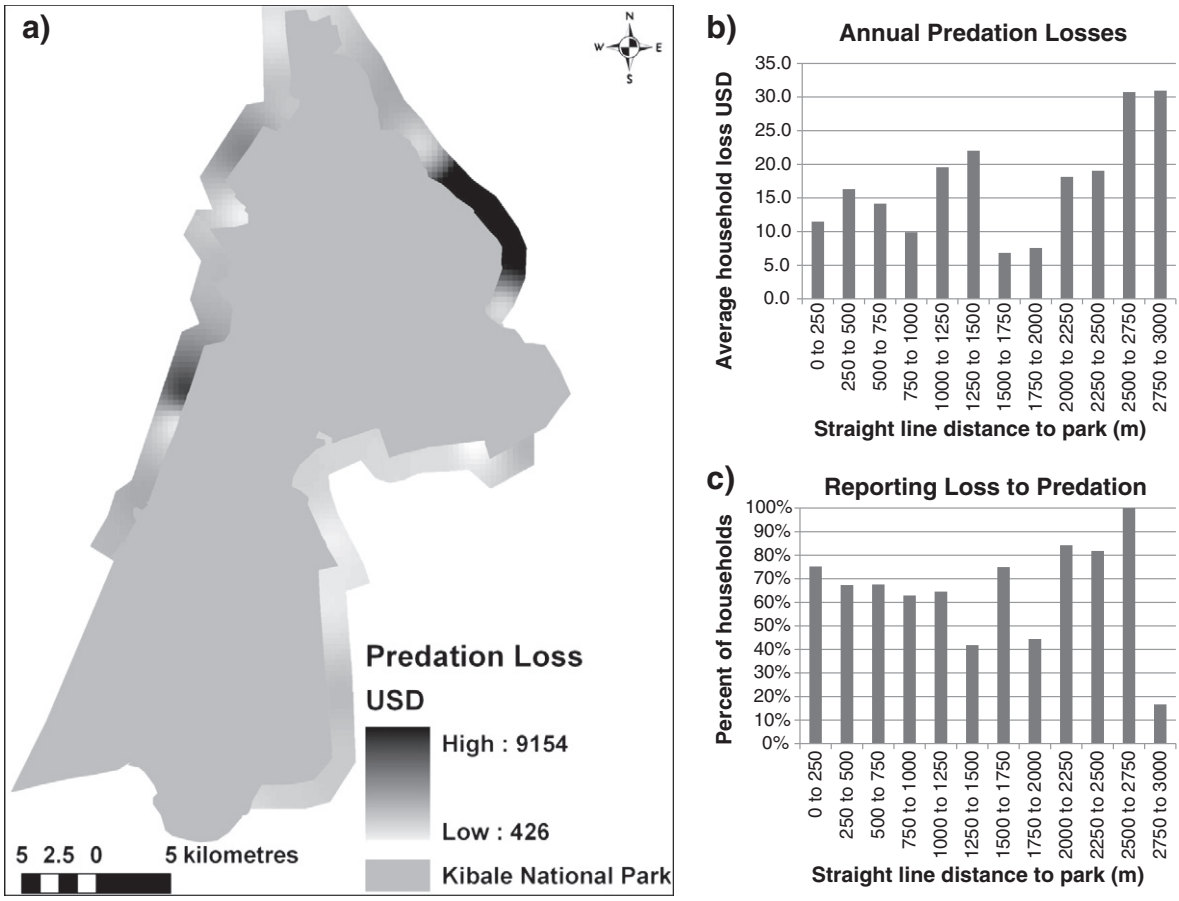

Fig. 7. Spatial distribution of predation losses around Kibale National Park, Uganda. a) Circumferential distribution of village-scale predation loss, b) Radial distribution of financial value lost to predation by park-protected animals, and c) Radial distribution of households reporting loss from predation.

of living next to the park, thus valuing only direct loss may understate loss relative to local perceptions.

3.4. Balance of Benefits and Losses

The village-valued total loss subtracted from total benefit (Fig. 8a) ranged from -US$21,864 to US$22,766, and resulted in eight villages summing to a net annual benefit, while 17 villages summed to a net annual loss; illustrating that benefits and losses are spatially inequitably distributed around the circumference of the park. Villages with a net benefit were located near park-based employment or were villages with beekeeping RAAs.

The percent of village households perceiving benefit minus the percent of village households perceiving loss (Fig. 8b) marginally correlated with the village-valued net balance ($r_{Pearson} = 0.399$, $p = 0.048$, $n = 25$). Only six villages had more households claiming benefit then households claiming loss, and the village-mean perceived loss was typically rated higher than the village-mean perceived benefit in each village (paired *t*-test, $p < 0.001$, $n = 25$). The radial distribution of the percent of households reporting benefit minus the percent of households reporting loss (Fig. 8c) indicates that households within 1 km of the park boundary perceived a distinct disadvantage relative to their neighbors living only slightly farther away.

4. Discussion

The spatial inequity of benefit and loss distribution has implications for conservation research, as conclusions drawn about the interaction between PAs and local livelihoods could be different depending on whether the benefits in a village are larger or smaller than the losses. The greatest losses accruing as a result of the park occurred within 0.5 km of the park boundary, and yet benefit accrual extended up to 15 km from the park. Therefore, at the scale of the PA, those living directly next to the park are disproportionately carrying the costs of conservation relative to those living only slightly farther away; analogous to PAs benefiting the global community while costing the local community (Wells, 1992), but at a much smaller scale. Organizations having discretion over the location of benefit provision, such as UWA and local governments in the case of revenue sharing projects, and NGOs in the case of development activities, need to consider focusing their benefits closer to the park boundary to support those who lose most from the existence of the park. Also, given the increased level of benefit near park-based employment, focusing revenue sharing projects and NGO activities away from park-based employment would more equitably distribute park-based benefits. Increasing the number of RAAs could also contribute to more equitable distribution of benefits, although the number of active RAAs may be limited by UWA manpower available to monitor agreements.

Given perceptions about living next to KNP were biased toward loss, perceptions about the park may be driven by loss aversion, where the disutility of losing something is valued higher than the utility of getting something of equal value (Thaler et al., 1992). This suggests that benefits would need to be disproportionately higher than losses to influence conservation behavior, implying loss mitigation, rather than benefit provision might be a better strategy to improve perceptions about the park.

Compensation has been recommended as a means to redress the losses carried by local people as a result of the existence of PAs (Adams and Hutton, 2007; Cernea and Schmidt-Soltau, 2006; Laudati, 2010), however, it may not be a sustainable solution to redress losses accrued due to crop raiding and predation. Most wildlife authorities in

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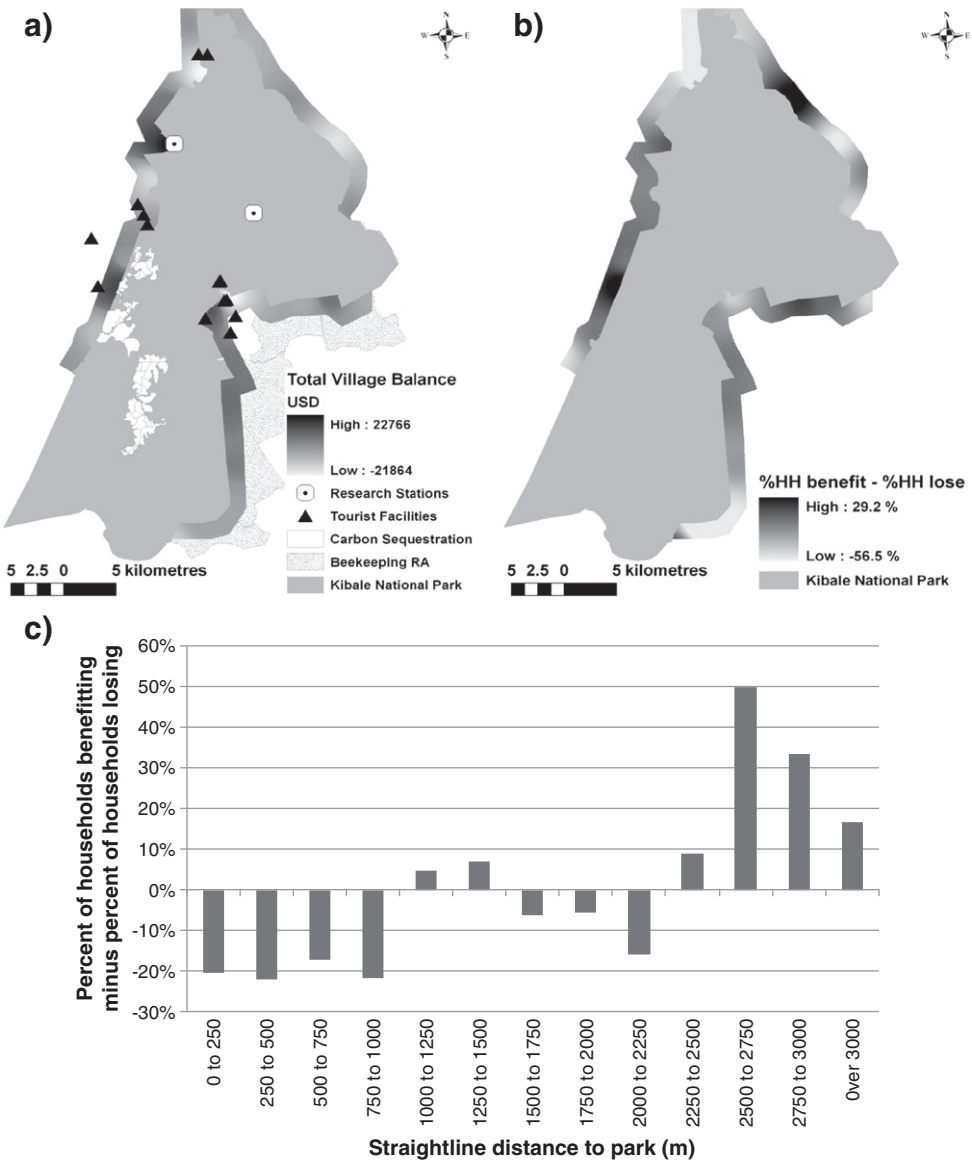

Fig. 8. Benefit-loss balance around Kibale National Park, Uganda. a) Circumferential distribution of village-valued benefit minus village-valued loss, b) Circumferential distribution of percent of village households perceiving benefit minus percent of village households perceiving loss as a result of living near the park, and c) Radial distribution of percent of households perceiving benefit minus percent of households perceiving loss as a result of living near the park.

developing countries do not have the funds to cover crop raiding and predation losses (Tchamba, 1996), and compensation programs require additional transactions costs to cover program management to guard against fraudulent claims and moral hazard (Bulte and Rondeau, 2005), and to confirm the damage was caused by park-protected animals (Nyhus et al., 2005). In many African countries, recovering animal populations and increased human settlement along the borders of PAs is leading to more crop raiding (Tweheyo et al., 2005), inflating the cost of any proposed compensation scheme. Although mitigating losses through the implementation of crop raiding and predation defenses would incur up-front and maintenance costs, I believe this presents a more sustainable option. The implementation of these defenses should be preferentially targeted to those villages accruing the highest loss.

5. Conclusions

Village-scale direct benefits and losses accrued as a result of the existence of KNP were spatially inequitably distributed with eight villages benefitting but many more accruing a net loss. Losses were highest within 0.5 km from the park, while benefit distribution extended up to 15 km from the park, requiring benefit provision, where possible, to be better targeted to households closer to the park.

Overall perceptions about the park appear to be shaped by loss aversion. To improve perceptions, conservation funds might be better spent on loss mitigation than on providing benefits through community development projects; although development projects may still be justified for poverty alleviation. To this end, revenue sharing funds should be focused on crop loss mitigation and additional funds should be raised by the conservation community to support loss mitigation efforts.

While the global community benefit from the continued protection of biodiversity in PAs, the communities living next to these PAs do incur losses. To address this inequity, more inventories of the costs and benefits of PAs are needed. These inventories can support the development of conservation strategies to minimize the burden of PAs on local communities while preserving biodiversity.

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References

Adams, W.M., Hutton, J., 2007. People, parks and poverty: Political ecology and biodiversity conservation. Conservation and Society 5, 147–183.

Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliot, J., Hutton, J., Roe, D., Vira, B., Wolmer, W., 2004. Biodiversity conservation and the eradication of poverty. Science 306, 1146–1149.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: The role of community in natural resource conservation. World Development 27, 629–649.

Archibald, K., Naughton-Treves, L., 2001. Tourism revenue-sharing around national parks in western Uganda: early efforts to identify and reward local communities. Environmental Conservation 28, 135–149.

Barrett, C.B., Arcese, P., 1995. Are Integrated Conservation-Development Projects (ICDPs) sustainable? On the conservation of large mammals in Sub-Saharan Africa. World Development 23, 1073–1084.

Books Open the World, 2007. Retrieved December 8, 2008, http://www.booksopentheworld.org/2007.

Brockington, D., Igoe, J., 2006. Evictions for conservation: A global overview. Conservation and Society 4, 424–470.

Brockington, D., Igoe, J., Schmidt-Soltau, K., 2006. Conservation human rights and poverty reduction. Conservation Biology 20, 250–252.

Brockington, D., Duffy, R., Igoe, J., 2008. Nature Unbound: Conservation, Capitalism and the Future of Protected Areas. Earthscan, London.

Bulte, E.H., Rondeau, D., 2005. Research and management viewpoint: Why compensating wildlife damages may be bad for conservation. Journal of Wildlife Management 69, 14–19.

Cernea, M.M., Schmidt-Soltau, K., 2006. Poverty risks and national parks: Policy issues in conservation and resettlement. World Development 34, 1808–1830.

Chapman, C.A., Lambert, J.E., 2000. Habitat alteration and the conservation of African primates: Case study of Kibale National Park, Uganda. American Journal of Primatology 50, 169–185.

Chhetri, P., Mugisha, A., White, S., 2003. Community resources use in Kibale and Mt. Elgon National Parks, Uganda. Parks 13, 28–49.

Chhetri, P.B., Barrow, E.G., Muhweezi, A., 2004. Securing Protected Area Integrity and Rural People's Livelihoods: Lessons from twelve years of the Kibale and Semliki conservation and development project. International Union for Conservation of Nature and Natural Resources, Nairobi.

Dixon, J.A., Sherman, P.B., 1991. Economics of protected areas. Ambio 20, 68–74.

Ellis, F., Bahiigwa, G., 2003. Livelihoods and rural poverty reduction in Uganda. World Development 31, 997–1013.

FACE the Future, 2011. Retrieved 6 May 2011 http://www.face-thefuture.com/en/projects/kibale-national-park-rehabilitation-project.

Feeney, P., 1998. Accountable aid: Local participation in major projects. Oxfam, Oxford.

Ferraro, P.J., 2002. The local cost of establishing protected areas in low-income nations: Ranomafana National Park, Madagascar. Ecological Economics 43, 261–275.

Ferraro, P.J., Kiss, A., 2002. Direct payments to conserve biodiversity. Science 298, 1718–1719.

Grieg-Gran, M., Bann, C., 2003. A closer look at payments and markets for environmental services. In: Gutman, P. (Ed.), From Goodwill to Payments for Environmental Services: A Survey of Financing Options for Sustainable Natural Resource Management in Developing Countries. World Wildlife Foundation:Macroeconomics Program Office, Washington DC, pp. 27–40.

Hamilton, A.C., 1984. Deforestation in Uganda. Oxford University Press, Nairobi.

Hartter, J., Goldman, A., 2010. Local responses to a forest park in western Uganda: alternative narrative on fortress conservation. Oryx 45, 60–68.

Hartter, J., Southworth, J., 2009. Dwindling resources and fragmentation of landscapes around parks: Wetlands and forest patches around Kibale National Park, Uganda. Landscape Ecology 24, 643–656.

Igoe, J., 2006. Measuring the costs and benefits of conservation to local communities. Journal of Ecological Anthropology 10, 72–77.

Jones, S., 2006. A political ecology of wildlife conservation in Africa. Review of African Political Economy 33, 483–495.

Kasiisi Project, 2008. Retrieved November 21, 2008 http://www.kasiisiproject.org/.

Kibale Fuel Wood Project, 2011. Retrieved January 15, 2011 http://newnaturefoundation.org/?page_id=12.

Kibale Health and Conservation Project, 2011. Retrieved May 10, 2011 http://kibale-health-conservation.mcgill.ca/.

Laudati, A.A., 2010. The encroaching forest: Struggles over land and resources on the boundary of Bwindi Impenetrable National Park, Uganda. Society and Natural Resources 23, 776–789.

Lepp, A., Holland, S., 2006. A comparison of attitudes towards state-led conservation and community-based conservation in the village of Bigodi, Uganda. Society and Natural Resources 19, 609–623.

MacKenzie, C.A., in press. Trenches like fences make good neighbours: Revenue sharing around Kibale National Park, Uganda. Journal for Nature Conservation, DOI: 10.1016/j.jnc.2011.08.006.

Mackenzie, C.A., Ahabyona, P., 2012. Elephants in the garden: Financial and social costs of crop raiding. Ecological Economics 75, 72–82.

MacKenzie, C.A., Hartter, J., in press. Demand and proximity: Drivers of illegal forest resource extraction. Oryx.

MacKenzie, C.A., Chapman, C.A., Sengupta, R., 2012. Spatial patterns of illegal resource extraction in Kibale National Park, Uganda. Environmental Conservation 39, 38–50.

McNeely, J.A., 1988. Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources. IUCN Gland, Switzerland.

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Naughton-Treves, L., 1999. Whose animals? A history of property rights to wildlife in Toro, Western Uganda. Land Degradation and Development 10, 311–328.

Naughton-Treves, L., Treves, A., 2005. Socio-ecological factors shaping local support for wildlife: crop-raiding by elephants and other wildlife in Africa. In: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge (UK), pp. 252–277.

Naughton-Treves, L., Buck Holland, M., Brandon, K., 2005. The role of protected areas in conserving biodiversity and sustaining local livelihoods. Annual Review of Environmental Resources 30, 219–252.

Naughton-Treves, L., Alix-Garcia, J., Chapman, C.A., 2011. Lessons about parks and poverty from a decade of forest loss and economic growth around Kibale National Park, Uganda. PNAS 108, 13919–13924.

Ninan, K.N., Jyothis, S., Babu, P., Ramakrishnappa, V., 2007. The Economics of Biodiversity Conservation: Valuation in Tropical Forest Ecosystems. Earthscan, London, UK.

Nyhus, P., Sumianto, Tilson, R., 2000. Crop-raiding elephants and conservation implications at Way Kambas National Park, Sumatra, Indonesia. Oryx 34, 262–275.

Nyhus, P.J., Osofsky, S.A., Ferraro, P., Madden, F., Fischer, H., 2005. Bearing the cost of human-wildlife conflict: the challenges of compensation schemes. In: Woodroffe, R., Thirgood, S., Rabibowitz, A. (Eds.), People and Wildlife: Conflict or Coexistance. Cambridge University Press, Cambridge, UK, pp. 107–121.

Pierce, D., 1998. Cost-benefit analysis and environmental policy. Oxford Review of Economic Policy 14, 84–100.

Plumptre, A., Behangana, M., Ndomba, E., Davenport, T., Kahindo, C., Kityo, R., Ssegawa, P., Eilu, G., Nkuutu, D., Owiunji, I., 2003. The Biodiversity of the Albertine Rift Valley. Albertine Rift technical report No. 3, Kampala, Uganda.

Robbins, P., McSweeney, K., Waite, T., Rice, J., 2006. Even conservation rules are made to be broken: Implications for biodiversity. Environmental Management 37, 162–169.

Shogren, J.F., Tschirhart, J., Anderson, T., Whritenour-Ando, A., Beissinger, S.R., Brookshire, D., Brown Jr., G.M., Coursey, D., Innes, R., Meyer, S.M., Polasky, S., 1999. Why economics matters for endangered species protection. Conservation Biology 13, 1257–1261.

Spiteri, A., Nepal, S.K., 2008. Evaluating local benefits from conservation in Nepal's Annapurna Conservation Area. Environmental Management 42, 391–401.

Tchamba, M.N., 1996. History and present status of the human/elephant conflict in the Waza-Logone region, Cameroon, West Africa. Biological Conservation 75, 35–41.

Thaler, R.H., Kahneman, D., Knetsch, J.L., 1992. The endowment effect, loss aversion, and status quo bias. In: Thaler, R.H. (Ed.), The Winner's Curse: Paradoxes and Anomalies of Economic Life. Princeton University Press, Princeton, pp. 63–78.

Tisdell, C.A., 2005. Economics of Environmental Conservation, second edition. Edward Elgar, Cheltenham, UK.

Tweheyo, M., Hill, C.M., Obua, J., 2005. Patterns of crop raiding by primates around Budongo Forest Reserve, Uganda. Wildlife Biology 11, 237–247.

Uganda UNITE, 2007. Retrieved May 1, 2011 http://www.nczoo.com/teachers/uganda unite.

Uganda Wildlife Statute, 1996. Retrieved March 25, 2008 http://faolex.fao.org/docs/texts/uga9000.doc.

UWA, 2002. Bwindi Community Initiatives that have contributed to poverty reduction within the local community populace through conservation and sustainable use of biodiversity. Uganda Wildlife Authority, Uganda.

UWA, 2009. Visitor Statistics. Uganda Wildlife Authority Internal Report. UWA, Kampala, Uganda.

Wells, M., 1992. Biodiversity conservation, affluence and poverty: Mismatched costs and benefits and efforts to remedy them. Ambio 21, 237–243.

West, P., Igoe, J., Brockington, D., 2006. Parks and peoples: The social impact of protected areas. Annual Review of Anthropology 35, 251–277.

Wilkie, D.S., Morelli, G.A., Demmer, J., Starkey, M., Telfer, P., Steil, M., 2006. Parks and people: Assessing the human welfare effects of establishing protected areas for biodiversity conservation. Conservation Biology 20, 247–249.