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Article

Improving the Conservation Status of the Udzungwa Mountains, Tanzania? The Effect of Joint Forest Management on Bushmeat Hunting in the Kilombero Nature Reserve

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Abstract

This study examines the effect of Joint Forest Management (JFM) in a component of the Kilombero Nature Reserve recently gazetted to improve the conservation status of high biodiversity forests in the Udzungwa Mountains of the Eastern Afromontane biodiversity hotspot. The evaluation is based on a temporal comparison spanning seven years of JFM and establishment of a Tanzania National Parks (TANAPA) ranger station, using bushmeat hunting as an indicator. Results reveal that the number of active hunters had declined, primarily due to TANAPA's patrolling. But hunting effort had been displaced from hunting with firearms in the grassland to hunting with traps and dogs in the forests, thus increasing the threat to endemic species. Hunters perceived few benefits from JFM, and the new opportunities were largely unused, inaccessible and communal in nature. Suspicions of embezzlement of JFM funds, and high village development contributions were important drivers of continuing hunting. Dissatisfied with JFM, most inactive hunters actually preferred that TANAPA manage the forest instead. Considerable attention to correcting these problems is required before this model of JFM should be scaled up and implemented in the remaining villages surrounding the Kilombero Nature Reserve.

Keywords: joint forest management, bushmeat hunting, compliance, displacement, governance, Udzungwa, Kilombero, Tanzania

INTRODUCTION

Developing nations have embraced decentralisation as a means to increase equity, efficiency and sustainability in the governance of natural resources (Agrawal & Ostrom 2001; Ribot 2004) and central governments are transferring varying degrees of decision-making authority to local institutions in participatory forest management (PFM) (Agrawal & Ribot 1999; Larson & Ribot 2007). By promoting public participation and moving decision-making closer to people, where it is assumed to be more transparent, flexible and responsive, PFM aims to provide local communities incentives for engaging in forest management (Hobley 1996; Petersen & Sandhövel 2001). The general expectation is that delegation of user rights and rights to collect revenue from natural resource exploitation will improve local livelihoods, and encourage sustainable use and protection of forest resources and biodiversity (Ostrom 1990; Ribot 2004). In addition, proponents expect that democracy, equity and efficiency will improve when significant autonomy and powers are devolved to local downward accountable and representative actors (Smoke 2003; Ribot 2004). This will occur because local people feel the cost and benefits of decisions on local matters more urgently, and are able to affect decision-making processes (Smoke 2003). As a result of the strong rhetoric, participatory approaches to conservation have spread rapidly in recent decades, and governments in more than 50 countries are pursuing initiatives that provide local users some degree of control over local resources (Agrawal 2001; White & Martin 2002). In Tanzania, 11% of the forest, involving more than 1,800 villages across the country, is now under PFM (Blomley *et al.* 2008).

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Although popular, debates remain about the efficiency of PFM, and the effect appears ambiguous. The role in halting change in deforestation is considered promising (Gautam *et al.* 2002, 2004; Gera *et al.* 2003; Blomley *et al.* 2008; Ellis & Poter-Bolland 2008), but evidence on equity and distribution of benefits indicates problems of elite capture and majority dominance (Kumar 2002; Malla *et al.* 2003; Richards *et al.* 2003; Meshack *et al.* 2006). Local elite have tended to dominate decision-making favouring strict forest protection sometimes encouraged by forest departments (Beck & Nesmith 2001; Neupane 2003), and because the poor tend to be the most dependent on forest resources (see Vedeld *et al.* 2007 for a review), the new and enforced access rules can negatively impact these households severely (Dev *et al.* 2003; Malla *et al.* 2003; Thomas 2008). Increased enforcement may also displace extraction activities to less well protected forests, leading to their degradation instead (Robinson & Lokina 2009). Ensuring user cooperation requires transparency and accountability (Blair 2000; Petersen & Sandhövel 2001). Tanzanian local governments, however, have a record of poor governance plagued by corruption, coercion and violence (Kelsall 2000; Fjeldstad 2001; Brockington 2007). Where village councils and village natural resource councils (VNRCs) are distrusted, or bribes accepted, illegal activities may therefore continue (Akpalu *et al.* 2009; Nielsen in review.). Finally, Joint Forest Management (JFM), implemented in government forest reserves without complete transfer of jurisdiction and with severe restrictions on resource use in consideration of catchment value and conservation of biodiversity, may be unable to generate sufficient benefits to compensate, and maintain community interest (Topp-Jørgensen *et al.* 2005; Blomley & Ramadhani 2006; Persha & Blomley 2009).

Despite these issues JFM is currently being implemented in villages surrounding the Kilombero Nature Reserve (KNR), gazetted September 2008, to improve the conservation status of high biodiversity forests in the Udzungwa Mountains (Marshall *et al.* 2008; United Republic of Tanzania 2009). The status as Nature Reserve is the highest protection under the Tanzanian Forestry and Beekeeping Division legislation, equivalent to the National Park status of the Tanzania National Parks Authority. Limited formal evaluation has been conducted of existing JFM programmes in the area. This study, therefore, aims to evaluate the effect of JFM through a temporal comparison of wildlife densities and hunting in the West Kilombero Scarp Forest Reserve (WKSFR) (now a component of KNR), spanning seven years of effective implementation of JFM and community-based patrolling. The analysis considers the effect of JFM on hunting and wildlife, the benefits perceived by hunters, and the reasons for any lack of willingness to adhere to rules and regulations.

STUDY AREA

The Udzungwa Mountains in the Eastern Arc Mountains are a component of the Eastern Afromontane biodiversity hotspot characterised by a particular high concentration of endemic species (Mittermeier *et al.* 2004). Within the Eastern Arc Mountains, the Udzungwa Mountains (Figure 1) are particularly important for conservation of biodiversity (Burgess *et al.* 2007; Rovero *et al.* 2009). A considerable number of new vertebrate species have been discovered in recent years, particularly in WKSFR (see Burgess *et al.* 2007). Larger species in WKSFR include Abbott's duiker (*Cephalophus spadix*), the newly discovered grey-faced elephant shrew (*Rhynchocyon udzungwensis*) (Rovero *et al.* 2008), and the two Udzungwa endemic primates Udzungwa red colobus (*Procolobus gordonorum*), and the kipunji (*Rungwecebus Kipunji*), a newly described genus (Davenport *et al.* 2006).

The forests in this hotspot have suffered extreme forest loss and fragmentation, reducing forest cover by 80% (Hall *et al.* 2009), leading to the threatened status of many wildlife species (Rovero *et al.* 2009). Logging was banned in the early 1990's, and a considerable proportion of the forests is today protected in government forest reserves. Unlicensed hunting by poor community members is currently the main threat to biodiversity (Nielsen 2006; Topp-Jørgensen *et al.* 2009). Unregulated bushmeat hunting is considered a significant threat to biodiversity in tropical forests (Robinson *et al.* 1999; Fa & Peres 2001; Fa *et al.* 2002; Milner-Gulland *et al.* 2003). Depletion of wildlife has consequences for the rural poor that depend on hunting for protein and income (Eves & Ruggiero 2000; Noss 2000; Fa *et al.* 2003; de Merode *et al.* 2004), and may also negatively affect forest regeneration and development by disrupting interactions with plants that rely on mammals for seed dispersal and recruitment (Nuñez-Iturri & Howe 2007; Wright *et al.* 2007; Brodie *et al.* 2009).

WKSFR (36º050–36º330E; 7º380–8º170S) (305 sq. km) is located in Kilolo district approximately 80 km east of Iringa. Two villages, Udekwa and Ifuwa, are located at some distance from the forest (>10 km), road access remains rudimentary and the area is considered remote and sparsely populated (5.051 people in 2008; United Republic of Tanzania 2009). The population consists primarily of Wahehe, an ethnic and linguistic group based in Iringa region, speaking the Bantu language Kihehe. Agriculture is the primary occupation, and trade in maize and soya beans constitutes the main source of income. People have few domestic animals, and hunting is conducted primarily for subsistence use with limited local trade. Formal employment and alternative sources of income are scarce.

WKSFR consists of three forest fragments, one of which is continuous with a large fragment in the Udzungwa Mountains National Park (Figure 1). The habitat type is submontane to upper montane forest habitat (Lovett 1993). Signs of hunting have not been recorded inside the forest by previous surveys and it has been assumed that hunting was concentrated in the grassland between the forests (Frontier 2001; Nielsen 2006; Topp-Jørgensen *et al.* 2009). Interviews with hunters in 2001, however, indicated that most forest dependent species were occasionally hunted (Nielsen 2004). Surveys were therefore conducted within the forest more than 1 km from the edge and far from human habitation, at altitudes ranging from 1,600–2,100 m above msl.

The MEMA (Matumizi Endelevu ya Msitu ya Asili) project funded by the Danish government between 1999 and 2004 provided support for awareness campaigns, forest boundary demarcation, formulation of management plans, and facilitated the election of VNRCs by village general assemblies. Management agreements were officially enacted in February 2002. Elections of VNRC members are scheduled every five years and VNRCs have four patrol guards linked to the committee. Management rights and responsibilities are vested in management plans and village by-laws, and the VNRCs have executive power to plan and perform forest management operations such as patrols, fire control, tree planting and arresting offenders, as well as rights to issue permits and collect fees from natural resource use (primarily honey, medicine plants, bark and a few forest vegetables) (District Land and Natural Resource Office 2002). Wildlife is not included in the management plan, and exploitation requires a permit from the District Wildlife Authorities in accordance with Tanzania's Wildlife Policy (United Republic of Tanzania 1998a), whose legal basis and administrative framework for local management, although developed in parallel, remains incompatible with that of the Forest Policy (United Republic of Tanzania 1998b; Nelson & Blomley 2007). While management responsibilities in PFM are vested in a committee under the auspice of the elected village council, establishment of community-based wildlife management requires formation of a new community-based organisation, across villages surrounding the proposed Wildlife Management Area (WMA). The community-based organisation will have considerable power over village lands and resources compared to village councils, thus creating problems in ensuring downward accountability (Nelson & Blomley 2007). Although JFM communities are not allowed to use or collect any revenue from wildlife, according to management plans VNRCs are required to protect their forest against illegal hunting (Topp-Jørgensen *et al*. 2005). The VNRCs are entitled to finance expenditure related to forest management from their own taxation, while all remaining funds must be used for public services (Lund 2007). The VNRCs have a joint bank account managed by a zonal committee consisting of representatives from the VNRCs in Udekwa and Ifuwa.

An ecological and financial monitoring system based on weekly patrols by VNRC patrol guards and summary of transactions recorded in VNRC accounts was implemented

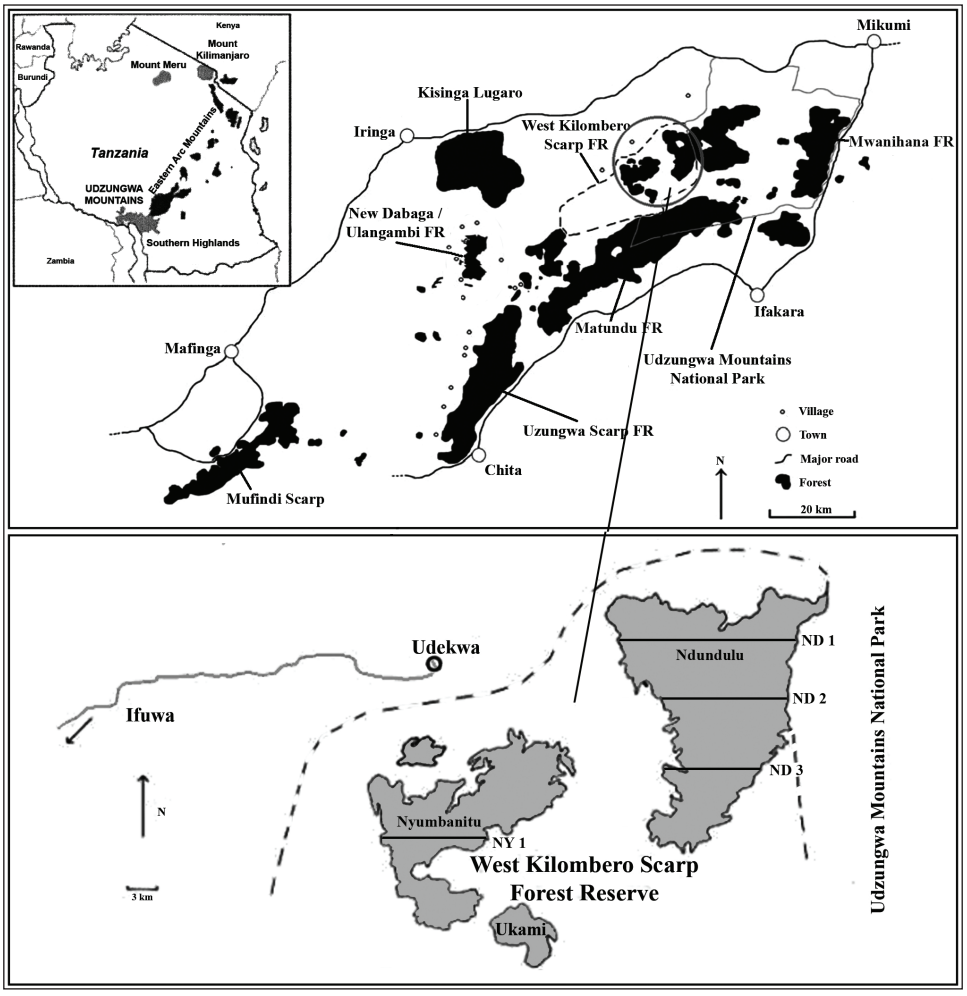

Figure 1
Map of transects in the study area within Tanzania modified from Froniter (2001)

in 2003 (Topp-Jørgensen *et al.* 2005; Funder *et al.* in review). The system requires the VNRCs to prepare and submit monthly reports on its ecological monitoring, taxation income and spending to present accounts at quarterly village meetings (Topp-Jørgensen *et al.* 2005). VNRCs do not have the power to make or change rules, and are in practice, restricted to enforcing objectives in the management plan that was developed by the District Land and Natural Resource Office (DLNRO), with limited input from the communities, and with no consultation of hunters due to the highly criminalised nature of this activity. The DLNRO is envisaged primarily to support the communities, but maintain a control function in relation to the objectives of the management plan. This includes the ability to recommend to the Director of the Forestry and Beekeeping Division under the Ministry of Natural Resources and Tourism to revoke management agreements. Based on Ribot's (2004) typology the type and level of PFM is thus best described as deconcentration, because powers are transferred from the central government ministry to district councils. But JFM is implemented as co-management with aspects of political decentralisation, albeit far from perfect, because VNRCs are accountable to elected village councils.

Recognising the areas of conservation importance, and to protect this back entrance to Udzungwa Mountains National Park, Tanzania National Parks (TANAPA), a parastatal organisation with legal mandate to manage and protect Tanzania's National Parks, started constructing a ranger station in Udekwa in 2001. Rangers have since been conducting regular patrols in the area, but TANAPA holds no formal management rights and its jurisdiction and presence in the area, which falls under the Forestry and Beekeeping Divisions authority, has been contested (J. Massao pers com). There is no sharing of gate fees to the National Park between TANAPA and the communities, but TANAPA has financed a number of local projects since the establishment of the ranger station in the area. These include upgrading the road to Ilulla on the Iringa-Morogoro highway, constructing a police station, as well as providing jobs for people in relation to establishing a tourist trail network in Ndundulu.

METHODS

The study is based on quantitative as well as qualitative enquiry using a multitude of approaches including transect surveys, socioeconomic surveys, structured and semi-structured interviews, and focus group discussions, over the course of 15 months of fieldwork in the general area in 2001–2002 and 2008–2009.

Biophysical Surveys

Changes in densities of wildlife and traps used by bushmeat hunters were selected as easily quantifiable indicators of conservation outcome in WKSFR. Relative densities of giant pouched rat (*Cricetomys gambianus*), eastern tree hyrax (*Dendrohyrax validus*), African elephant (*Loxodonta africana*), bush pig (*Potamochoerus larvatus*), African buffalo (*Syncerus caffer*), suni (*Neotragus moschatus*), blue duiker (*Cephalophus monticola*), Harvey's duiker (*C. harveyi*) and Abbott's duiker (*C. spadix*) were determined, based on scats and active burrows, using variable width line transect sampling (Burnham *et al.* 1980). A total of 11.20 km divided on five transects were surveyed in the dry season from July to September in 2001 and 2008 using the same two local assistants (see Nielsen 2006 for further details). Observations were truncated at 5%, grouped in appropriate intervals, and relative densities were estimated using Distance 5.0 release 2 (Thomas *et al.* 2006) and the uniform detection function with cosine expansion (Buckland *et al.* 2001). Individual transects were surveyed in 200 m intervals separated by 50 m to facilitate calculation of confidence intervals (Buckland *et al.* 2001). In case of insufficient observations, the detection function and specifications for all transects combined was used to estimate the density. Due to low number of observations, densities of human disturbances were assessed using fixed area search 5 m to either side of the transect (Eberhardt 1978). The line intersect method was used to quantify the number of human trails (Eberhardt 1978). Changes were considered significant if 95% confidence intervals were non-overlapping (Buckland *et al*. 2001). Lack of data on wildlife changes, collected using similar methods in a comparable non-JFM location, prevents assessment of the causal effect of JFM. Instead, cause and effect of observed changes in relative wildlife densities and human disturbance was assessed through focus group discussions and interviews with hunters, VNRCs, DLNRO and TANAPA staff.

Perception Surveys and Focus Group Discussions

Information on hunting and hunters' livelihoods was obtained directly from hunters in Udekwa and Ifuwa with the aid of a local assistant. Hunters were initially wary as hunting in forest reserves is illegal and hunters are highly criminalised, but their cooperation was gradually attained through a snowball method (Patton 1990). Hunters that were hunting in 2008 are hereafter referred to as active hunters and those that had stopped hunting as inactive hunters. The total number of active hunters in 2001 and 2008 was determined through the local knowledge of the cooperating hunters, and through interviews with individuals from a list of people owning firearms, compiled by TANAPA in 2005. Structured interviews of 40 inactive hunters were conducted in 2008. Questions assessed perceived direct and indirect economic as well as non-economic benefits from JFM, attitudes towards the VNRCs, TANAPA, and participation in village and JFM activities.

Focus group discussions with active and inactive hunters were conducted in March 2009, using an interview guide developed from Ostrom's (1998) framework of reputation, trust, and corporation. Five sessions with a total of 39 people were conducted. Two groups were active hunters and the rest inactive hunters. Questions assessed participants' understanding of and participation in JFM, the level of benefits expected and

received, reputation of the VNRCs, and trust in their financial management, as well as reasons for stopping or continuing hunting. Key points raised were reviewed with local assistants immediately after focus groups for verification and validation. Names of participants and respondents, and their village of residence are kept confidential to protect their privacy.

Audit of VNRC Records

VNRC receipts, vouchers, monitoring reports and meeting minutes from July 2002 to July 2008 were examined. Transactions were coded in categories to evaluate distribution of income, and share used on public services following Lund (2007). A full bank statement of the joint account was obtained with the assistance of the zonal committee accountant for the two villages. The share of income accounted for was determined as an indicator of good governance. Tanzanian shillings (TZS) were converted to USD using average exchange rates between January and June 2008 (1:0.00087; www.oanda.com). Semi-structured interviews were conducted with community members, VNRCs, village government, DLNRO staff, and the manager of the Kilombero Nature Reserve (previous regional catchment forest officer), triangulating information on VNRCs' and village authorities' management procedures, handling of offences and known cases of embezzlement.

RESULTS

Changes in Wildlife and Hunting

Results reveal a general, although not significant, increase in relative densities of most species (Figures 2–9). However, considerable variation in changes occurred between transects. Blue duiker (significant), Harvey's duiker, and giant pouched rat had increased in Nyumbanitu forest (transect NY1), while eastern tree hyrax, Abbott's duiker, bush pig, and buffalo had declined. Relative densities of all three duikers had increased on the transect closest to TANAPA's ranger station (transect ND1), which is also the transect closest to Udekwa, intersected by a new tourist trail and changes indicate a decline of giant pouched rat, eastern tree hyrax, bush pig and elephant. Giant pouched rat, elephant, blue and Harvey's duiker remained stable or increased on transects further from Udekwa (ND2 and ND3). But Abbott's duiker, bush pig and buffalo had declined on the transect at intermediate distance (transect ND2). Thus, as a rough generalisation, the observed pattern was an increase of relative densities of smaller duikers on transects closer to human habitation but a decline of medium (and eastern tree hyrax) and larger species on these transects and the transect at intermediate distance, whereas medium sized species remained stable on the transect farthest from villages.

Observations related to hunting were absent inside the forests in 2001, but in 2008 a density of 27 traps per sq. km was observed, with traps found on and around transects NY1 and ND2. In addition two camps with sticks for drying meat, and the hides of two Abbott's duikers were found in Nyumbanitu. Hunters with dogs were also heard on several occasions from transect ND2 in Ndundulu. Contrary to 2001, logging and pole cutting were also recorded in both forests (NY1 and ND2), and a number of human trails had been established (NY1, ND1 and ND2) (excluding TANAPA tourist trails). Positive correlations were observed between number of human trails (excluding TANAPA tourist trails) and densities of traps (r_8=0.99; P<0.01), pole cutting (r_8=0.89; P=0.01), and logging (r_8=0.87; P<0.01, log transformed).

Number of active hunters had declined in both Udekwa and Ifuwa (Table 1). Ninety-one active hunters were identified in 2001 through snowball sampling and the local knowledge of collaborating hunters. Additional hunters were identified from TANAPA's list of people owning firearms, bringing the total number of active hunters in 2001 to at least 130. According to TANAPA's list seven rifles, five shotguns and 51 locally produced guns were owned by people in the two villages in 2005. In 2008, the number of active hunters had been reduced to 78 and considerable substitution had occurred. In Udekwa, 66 hunters had stopped hunting, but 35 primarily teenage boys had started. In Ifuwa, 30 people had stopped hunting and nine had started. In addition, most firearms had been handed over in a safe-conduct period or subsequently confiscated by TANAPA (Table 1). Excluding other reasons for stopping hunting (dying or moving away), and assuming that meat supply and demand had remained stable, the effect of JFM and the TANAPA ranger station was a 33% reduction in hunting intensity (Table 1).

Most had stopped hunting because of fear of TANAPA whereas VNRC patrol guards were considered few and ill-equipped. In addition to jail, hunters feared physical punishment, recounting stories of hunters having been beaten by TANAPA rangers. According to the corporal at the TANAPA ranger station, armed patrols were conducted several times a week, with occasional overnight stays in the reserve having resulted in a considerable number of arrests. In comparison, VNRC guards in Udekwa and Ifuwa patrolled unarmed with very limited equipment, on average 1–2 times

Table 1

Change in number of hunters

	Udekwa	Ifuwa	Total
2001			
Active hunters	79	51	130
Hunters owning firearms	21	28	49
2008			
Active hunters	48	30	78
Hunters owning firearms	3	9	12
Dead/moved	14	0	14
Change			
Total reduction	39%	41%	40%
Excl. natural change	26%	41%	33%

Change in number of 'active hunters' and 'active hunters owning firearms' from 2001 to 2008. Included is also information on 'natural' reasons for reduction in number of active hunters in terms of number that had died or moved away. Finally the total percentage change since 2001 and the change excluding 'natural' sources of reduction is presented.

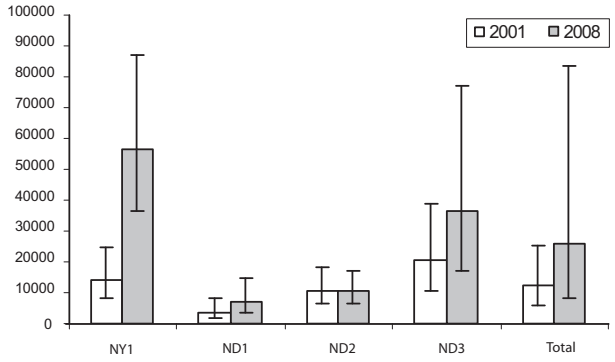

Figure 2
Change in blue duiker dung per sq. km in WKSFR

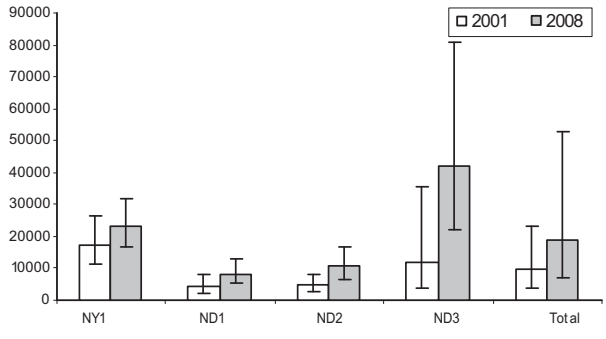

Figure 3
Change in Harvey's duiker dung per sq. km in WKSFR

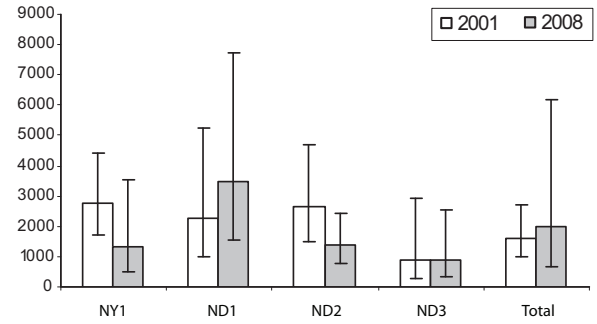

Figure 4
Change in Abbott's duiker dung per sq. km in WKSFR

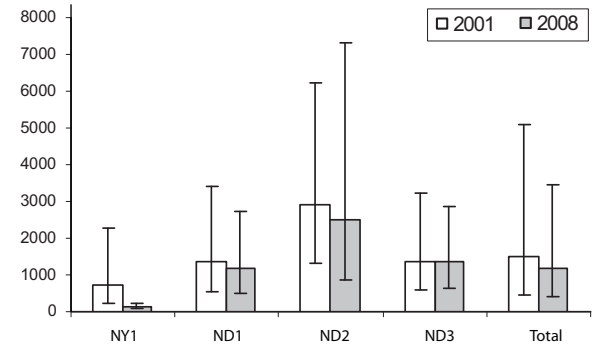

Figure 5
Change in bush pig dung per sq. km in WKSFR

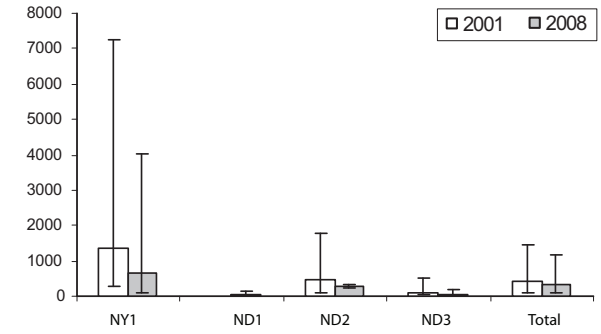

Figure 6
Change in African buffalo dung per sq. km in WKSFR

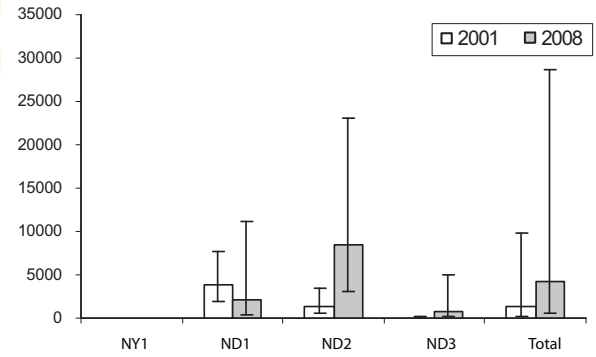

Figure 7
Change in African elephant dung per sq. km in WKSFR

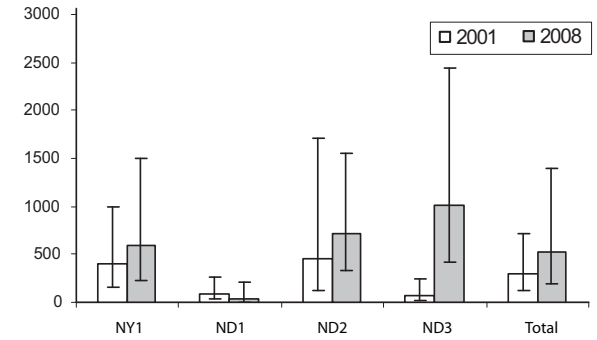

Figure 8
Change in active giant pouched rat burrows per sq. km in WKSFR

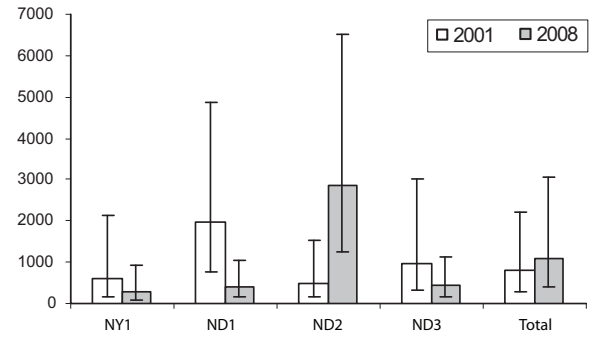

Figure 9
Change in communaleastern tree hyrax latrines per sq. km in WKSFR

per month, with each patrol of approximately 2.5–5.75 hours duration according to monthly monitoring reports. No arrests had been made by the patrol guards for hunting inside the forest.

Not until several years after implementation, had hunters received information about potential income from tourism, and started expecting future benefits from JFM if they stopped hunting. But most acknowledged that hunting continued. To avoid detection and due to confiscation of firearms, active hunters in 2008 stated having shifted from hunting buffalo and bushbuck (*Tragelaphus scriptus*) in the grassland between the forests, to hunting with traps and dogs inside Nyanbanitu and around ND1 and ND2 in Ndundulu, where they caught Abbott's duiker, bush pig and eastern tree hyrax.

Effects on Local Livelihoods

Approximately 81% of inactive hunters were aware that JFM had been implemented in their village, and possessed a basic understanding of the concept. However, only 18% expressed satisfaction with the benefits obtained as a result. The proportion that perceived having obtained direct economic, indirect economic, and non-economic benefits from the implementation of JFM was, 47%, 55%, and 32% respectively. Direct economic benefits mentioned were permits for harvesting forest products for own and commercial use. However, only 36% had actually applied for a permit, and none within the past year. Indirect economic benefits mentioned included receiving information on domestic animal and bee-keeping and woodlot management. But only two inactive hunters had joined a beekeeping group, and two others a loan and savings groups. Non-economic benefits mentioned primarily referred to school repairs. Active hunter focus groups perceived particularly few benefits, whereas inactive hunters were more positive mentioning contribution of VNRCs to local development. It was clear that most people in both groups had expected JFM to generate income for local development, so that they would not have to pay village development contributions (VDCs). Some directly considered receiving no benefit from JFM because they still had to pay VDCs. The funded projects were furthermore considered insignificant compared to the assumed income of the VNRC.

Reasons for Hunting

Focus group discussions indicated a development in the function and importance of hunting. Both active and inactive hunter groups claimed that Hehe people traditionally did not keep domestic animals, and historically have depended on hunting. As domestic animals became more common, hunting had changed to a recreational activity, gap filler, and safety net (e.g., "if people have a sick child", and in order "to be able to pay village development contributions"). VDCs seen as increasingly excessive and unfair remained an important reason for hunting in 2008. VDC are determined and set by village or ward government without consulting the village general assembly. Heads of households unable to pay are jailed until the amount and a fine of 10.000 TZS (8.7 USD) is paid, occasionally forcing people to sell belongings and food stores. VDCs have been levied for construction and repair of village and ward infrastructure, but projects are often left unfinished leading to speculations about embezzlement.

Active hunters, in addition, stated continuing because they did not trust the VNRC, or expect benefits from JFM. Virtually all group members and most respondents (73%) did not trust the VNRC, and rumours of embezzlement circulated, fuelled by few and unfinished communal projects, and lack of information on accounts. Approximately 70% of respondents claimed not having received information about VNRC accounts at village meetings, as required by the management plan. As a result of complaints, the DLNRO had in 2006 confiscated VNRC receipt and voucher books in one village, but without conducting a formal audit. It was therefore seen as an attempt to protect the VNRC and cover up misconduct. As a result, both active and inactive hunters expected no benefits from JFM, stating "I don't believe that local development will ever happen because of the VNRC. Tourists might come but [name of VNRC chairman] will not give us any development projects". This also perpetuated hunting, by rendering inactive hunters unwilling to assist in preventing illegal activities, as exemplified by the statement, "I cannot report on others as long as the leaders are just eating the money." Failure to do so was subject to a considerable fine.

Discontent was specifically directed against a VNRC chairman who was accused of embezzlement and adultery with married women (a trial of a claim for compensation for assault by the chairman, raised by the husband of one of these women, was witnessed at the village office in 2008). The fact that this individual was elected to the committee in 2001 and allowed to continue in 2005 was a result of less than democratic election procedures, according to focus group members. Initial elections were thus based on screened applications and pre-selection by the village council and the DLNRO, leaving no actual choice for the village general assembly. Several VNRC members were changed in 2005, but considerable disagreement surrounds the election procedure. Some claimed that the DLNRO intervened, demanding re-election of the chairman due to the extent of training he had received. Others claimed that he was re-elected because the procedure followed was election of one member by each sub-village, enabling support to the chairman from relatives living in his sub-village. Finally, it was claimed that no election had been held and that VNRC members were determined by the DLNRO, ward or district authorities. Figuring out exactly how the election was conducted, and examining each rumour about embezzlement is beyond the scope of this study, and is inhibited by lack of documentation. DLNRO staff, however, did confirm having intervened in elections to ensure that particular members having received training maintained VNRC membership.

An audit was also conducted of VNRC accounts. One hundred forty individual receipts, 70 individual vouchers, and 78 monthly monitoring reports were examined. Records cover 131 of 216 months for the two VNRCs and their common zonal

committee. Based on the serial numbers, 41% of the receipts and 92% of the vouchers were obtained (42 additional receipts were bank deposit receipts or could otherwise not be assigned to a series). According to records, 24% of expenditure was on public services, 4% on administration (salary for VNRC members) and most of the rest of the recorded expenditure on operational management (provision, transport and salaries for patrol guards and workers making forest boundary clearing etc., and for VNRC members undertaking specific management related assignments). Projects funded by the VNRCs included forest boundary clearing (paid by the DLNRO), purchasing school books, desks, and constructing toilets for the ward secondary school. However, several people complained not having been paid for forest boundary clearing, while others complained having been fined without receiving a receipt. Vouchers were often not signed or signed by VNRC members. There were also discrepancies between the amounts and items recorded in vouchers and those stated received by contractors and the school headmaster, respectively. Finally, most VNRC projects on inspection remained unfinished. The share of income accounted for was 82–97%, depending on the level of strictness applied in relation to ambiguous receipts.

In stark contrast to the reservations against the VNRC, 86% of interviewed hunters felt that they had benefitted from projects conducted by TANAPA, mentioning repair and construction on the school, dispensary and police station and upgrading of the road. As a result, 89% were positive towards TANAPA's presence in the area. Reasons for dissatisfaction were related to incidences where TANAPA rangers allegedly had arrested people for hunting that was actually crop protection, and examples of offenders being beaten up or humiliated. An area in Ndundulu for instance, was called *chupi* (underwear) because rangers allegedly had burned clothes of hunters caught there, forcing them to walk home in their underwear. Despite these incidences, 70% of interviewed inactive hunters, and all three focus groups with inactive hunters preferred that TANAPA manage the forest instead of the VNRC, primarily because TANAPA showed results and provided local development.

DISCUSSION

Displacement of Hunting Effort

Efforts to reduce illegal hunting in WKSFR do not appear to have been particularly successful. Despite patrols by both TANAPA rangers and VNRC patrol guards, the reduction in number of active hunters was considerably less than the 79% reduction achieved in the adjacent New Dabaga Ulongambi Forest Reserve (Nielsen in review). The additional attention on enforcement, as a result of TANAPA's presence, should hypothetically make it more difficult to identify hunters in WKSFR in 2008, thus supporting this result. In addition, the displacement created by the patrolling appears to have increased the threat to endemic and IUCN listed forest dependent species. Hunters' statements (of having shifted from hunting common species in the grassland to hunting Abbott's duiker, bush pig and eastern tree hyrax in the forests) were in most cases consistent with spatial changes in human disturbance and relative wildlife densities. Despite decreasing relative densities of some targeted species, no sign of hunting was recorded on transect ND1. However, the adolescent boys who had started hunting in 2008, stated primarily hunting eastern tree hyrax in this area. Despite the small size of the eastern tree hyraxes, they are a preferred prey choice due to the ease with which they can be caught. Hyraxes spend a large proportion of the day resting in tree cavities, from which they can easily be extracted with a harpoon-like device attached to a flexible rod. According to hunters, 30–40 hyraxes can be caught during one hunt, without requiring a return trip to check traps. Studies in the Udzungwa Mountains have, in this respect, indicated sensitivity of eastern tree hyrax to hunting (Topp-Jørgensen *et al.* 2008).

Results also indicated decreasing relative densities of buffalo and elephant on some transects. Apart from hunting, this could reflect that buffalos spend more time outside the forest, perhaps due to lower hunting pressure in the grassland. The general agreement that buffalo was observed closer to Udekwa in 2008 supports this explanation, that also could apply for bush pig. On the other hand, according to informers, a number of hunters from Ifuwa still used firearms and occasionally shot buffalo and elephants. Supporting this, a research assistant observed a man trying to sell dried elephant meat to bus passengers going from Ifuwa to Iringa. However, caution is required interpreting changes for large species such as elephant, due to their specific life history strategies and a resulting low number of observations.

Most changes were not significant and wildlife densities may also fluctuate as a result of environmental stochastic variation, independent of hunting (Lande 1993; Sæther 1997), and there is some indication of a mast-year (particular high tree seed production) in the period between surveys (Topp-Jørgensen & Nielsen unpubl. data). This could explain the increase in relative densities of blue duiker and Harvey's duiker, despite increased hunting in the forest (including that on transect ND3). Alternatively, hunters appear to be able to selectively target Abbott's duiker and bush pig, in which case the increase of smaller duikers may be explained by competitive release (Newing 2001; Prins *et al.* 2006).

The reason for the comparatively little success in reducing illegal hunting in WKSFR as compared to NDUFR is not clear, but the comparability of the two locations suggests that the explanation is not to be found in general change in livelihoods in WKSFR. Instead, the reason for the limited success may be related to the lower opportunity cost of hunting in this remote area with few income generating activities, the rugged topography and large area of WKSFR making efficient patrolling difficult, and the higher animal densities compared to NDUFR, making hunting more lucrative (Nielsen 2006, in review). What is clear is that the achieved reduction in number of hunters was primarily due to TANAPA rangers, with little or no impact of VNRC patrol guards. Unfortunately, it was not possible to obtain detailed information on number, duration,

spatial distribution, observations and arrests during patrols from TANAPA for a formal assessment of effort and outcome. Although monthly monitoring reports containing similar information on VNRC patrols are available, the validity of the information is uncertain (Nielsen & Lund forthcoming).

Benefits of JFM

Ideally, evaluating the effects of JFM on forest users requires comparison with a location where JFM has not been implemented (Ferraro & Pattanayak 2006; Lund *et al.* 2009), or alternatively with a control group in the village that did not use forest products before JFM (see Nielsen in review). However, in case such a counterfactual group is lacking, users' own perceptions can indicate how JFM affects households. In WKSFR, the few benefits and opportunities associated with JFM were unused, inaccessible to the hunters or communal in nature. For instance, products that could be harvested with permits, were available outside the forest and hence the arrangement was largely unused. None of the hunters had become members of seven groups for rearing domestic animals with approximately ten members each, because this required start capital as well as friendly relations with the VNRC and village leaders. Only few people perceived having received tangible communal benefits and a large proportion considered that JFM had failed because they still had to pay VDCs. Upgrading of the road by TANAPA has presumably improved market access for agricultural products. However, evidence from NDUFR indicates that hunters constitute an assets-poor group in the communities that have limited ability to take advantage of new opportunities presented by JFM (Nielsen in review). In combination, this suggests that inactive hunters have not been compensated for the loss of access to wildlife, and may have experienced negative net impacts of the implementation of JFM. Similar low benefits or negative net impacts of JFM have been observed elsewhere in Tanzania with implication for community interest (Persha & Blomley 2009; Nielsen in review).

It thus seems evident that hunters have not received sufficient incentive to voluntarily stop hunting. Although the proportion of VNRC revenue used for public services was high compared to other areas (Lund 2007; Nielsen in review), VNRCs only generated an average of 486 USD per year (equivalent to approximately 0.09 USD person/year) thus providing limited opportunity for local development. Although higher than indicated by previous research (352 USD) (Topp-Jørgensen *et al.* 2005), this amount is quite low compared to villages in the woodlands (average 606 USD, n=14) (Lund 2007), particularly compared to a well functioning village (1411 USD) (Lund & Treue 2008), and may be not be sufficiently tangible to maintain local interest or finance administration and operational management.

Disincentives for Compliance

Both instrumental and normative aspects can explain the lack of compliance with regulations (Zaelke *et al.* 2005). Instrumental aspects in this case include insufficient domestic animals, lack of funds for purchasing meat, and pressure to pay high VDCs, combined with low risk of getting caught. Inability to pay VDCs, school fees, etc., has been cited as the reason for bushmeat hunting in other locations (Loibooki *et al.* 2002; Neumann 2004). Normative aspects include suspected embezzlement with VNRC and village funds. In addition, discontent with VNRC members and perceptions of less than democratic standards lead people to question the authority of the VNRCs, and the legitimacy of the rules and regulations under JFM. Most hunters suspected that VNRC members as well as village, ward and district leaders embezzled funds and as a result were unwilling to cooperate with village and ward level development objectives. Results revealed a high share of income accounted for compared to other locations (Lund 2007; Nielsen in review.). However, 59% of receipts were missing according to receipt serial numbers, and offenders had paid fines without receiving a receipt, indicating that their suspicions may be warranted. But the lack of trust in VNRC members should be seen in a historical context. At least three consecutive village executive officers (government appointed and employed civil servants attached to each village council) were removed following complaints from community members about coercion, embezzlement, and outright violence and torture. Some of these aspects were witnessed during fieldwork in 2001. Fortunately, it appears that a group of younger community members had succeeded in bringing complaints to the appropriate authorities, resulting in transfer of these village executive officers. The situation differed in relation to VNRC members that were seen as very close to the DLNRO, and therefore difficult to oppose and confront. Most people either did not know that they had legal rights to access the VNRC accounts, or chose to avoid open confrontation with village leaders.

Despite a less democratic and participatory profile, attitudes towards TANAPA were generally positive as reported from other locations where extension services have been provided (Mulder *et al.* 2007). The benefits provided by TANAPA's outreach programs are, however, not linked to or conditional on local actions supportive of conservation, and tend to be viewed as handouts (Binot *et al.* 2009).

Recommendations

JFM is planned to be implemented in all 18 villages surrounding KNR that was gazetted to improve the conservation status of the Udzungwa Mountains (United Republic of Tanzania 2009). The limited information available on conservation plans in the Udzungwa Mountains emphasises education, raising awareness, and providing realistic alternative community livelihoods (Marshall *et al.* 2008), in combination with development of government-community management regimes (Sumbi *et al.* 2005). However, results indicate that hunters have received no tangible benefits, and very limited local development from the implementation of JFM in WKSFR,

and the VNRCs in which management responsibilities are vested, were widely distrusted. In fact, the dissatisfaction with the VNRCs had reached a level where even hunters preferred that TANAPA manage the forest instead of the VNRCs. Furthermore, despite resulting in a decrease in the number of active hunters, the increased law enforcement had actually resulted in an increased threat to endemic species, by displacing hunting activities from the grassland to the forests. Although the effect of trends in habitat quality cannot be excluded and most changes in wildlife densities were not significant, the occurrence of a displacement effect was supported by several independent strands of evidence. These include statements on change in hunting practice by hunters, the large number of firearms confiscated by TANAPA, changes in traps and other evidence of hunting in the forest and finally changes in relative wildlife densities in the forest.

Within the current JFM framework, there is very limited potential for generating income to improve local livelihoods and thereby provide instrumental reasons for compliance with wildlife management rules and regulations. However, the normative reasons for non-compliance can be addressed within the framework of JFM. Attention should be directed to correcting these aspects before this model of JFM is scaled up and implemented in the rest of the villages surrounding KNR. This includes making sure that democratic standards are adhered to, and that elections are not influenced by higher level authorities, so VNRCs remain genuinely accountable to the community. This should be facilitated by increasing the transparency of transactions, by emphasising that quarterly presentation of accounts by the VNRCs to the wider community are adhered to, in agreement with the management plan. In addition, village general assemblies should be consulted on use of VNRC funds (as well as in setting and determining the use of VDCs). And since VDCs appear to be an important driving factor of hunting, the amount demanded should be reduced proportional to the income from JFM, in order to establish a direct link between JFM and local development and create incentives for community cooperation (Salafsky & Wollenberg 2000). Finally, an independent audit group should be established in each village to ensure swift detection and action on irregularities in accounts. This could contribute to improving trust in VNRCs (Klooster 2000) with implications for hunters' will to adhere to rules and regulations (Nielsen & Meilby in review).

Ensuring long term community interest and compensating local mangers for protecting a forest, that primarily produces national and international important ecosystem services, ultimately requires increasing the VNRC's income. Implementing a tax on downstream water use for hydroelectricity production has a major potential for financing local forest management in the Udzungwa Mountains (Pfliegner & Burgess 2005). However, the modality of payments is yet to be worked out. Another highly relevant avenue of funding is the Reduced Emissions from Deforestation and Forest Degradation (REDD) scheme that could generate an estimated 117 USD per household per year (Zahabu 2008) if all deforestation and degradation in Tanzania was halted. However, monitoring and verifying the efficiency of communities' efforts under REDD may become a challenge (Nielsen & Lund forthcoming).

Until these issues are solved, effective patrolling by properly motivated guards appears essential for reducing hunting, in order to protect the unique biodiversity of these forests. The suggestion to exclude TANAPA from the area (J. Massao pers com), that since the gazettement as Nature Reserve clearly falls outside TANAPA jurisdiction, may therefore prove counterproductive to conservation efforts. Alternatively or simultaneously, sustainable hunting of common species in the grassland between the forests should be considered, in order to decrease the pressure on endemic and IUCN listed forest dependent species, and generate tangible benefits targeted at those who make the day-to-day decisions that ultimately determine the fate of the area's wildlife. Inclusion of wildlife management rights in PFM in Tanzania could potentially contribute substantially to improving local livelihoods, as well as financing patrolling and management activities. It is, however, unclear to what extent it is possible to combine PFM and community-based wildlife management, as the equivalent of the Wildlife Policy, on the same area of land under the current legal framework (Nelson & Blomley 2007). Furthermore, although the Wildlife Policy supports subsistence hunting in WMAs, vested interests in the substantial income and rent seeking opportunities, arising from control over the allocation process for hunting concessions, appears to block any meaningful transfer of management powers over wildlife to communities, contrary to the spirit of the Wildlife Policy (Nelson *et al.* 2007). Although this clash of interest primarily occurs in relation to areas with a high potential for trophy hunting, the effects spill over into JFM areas and remain unlikely to be resolved any time soon (Nelson & Blomley 2007; Nelson *et al.* 2007).

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