Assessing the influence of the Mwaluganje Elephant Sanctuary on the local community in the North Shimba Hills Conservation Ecosystem, Kenya

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Introduction

Human-elephant conflict (HEC) is one of the most pressing issues facing conservationists in many elephant range areas of the world today (Bell, 1984; Hoare, 1995; Barnes, 1996; Kiiru, 1995a). The increase in proximity of human population, and the expansion of their agricultural activities into the elephants' range has been identified as the major cause of this conflict (Thouless, 1994; Thouless and Sakwa, 1995, Hoare, 1995). Research by conservationists (Barnes, 1996; Hoare, 1995; Kagwana, 1995; Thouless, 1994) has revealed that the conflict take different forms: elephants raiding crops, killing livestock, destroying water supplies, injuring and even killing people. In the face of these losses, many people in the neighbourhood of elephant protection zones have tended to have negative attitude towards elephants and the conservation authorities in charge of the protected areas (Ngure, 1995; Hoare, 1995; Kiiru, 1995b; Naughton-Treves, 1997, 1998).

In response to the rising level of HEC, several strategies have been tried as counteractive measures. Compensation, fencing, translocation, controlled shooting and other more advanced elephant crop raiding deterrents have been attempted (Thouless and Sakwa, 1995; Osborn, 2002; Kagwana 1995; Hoare, 1995). However, many of these strategies have been found to be effective only in the short term (de Boer and Ntumi, 2000; Hoare, 2001; Naughton-Treves, 1997, Osborn, 1998; Thouless and Sakwa, 1995) and, considering the livelihood of the local people, in real terms, many of them don't bring tangible benefits to the local communities involved (Thouless, 1995; Naughton-Treves, 1998; Kiiru, 1995b).

In the search for more effective and sustainable HEC mitigation strategies, many conservationists (Barnes, 1996; Thouless, 1994; Taylor, 1993; Nchanji and Lawson, 1998; Naughton-Treves, 1997, 1998) now believe that the key to finding a long-term solution to the HEC problem is two fold. Firstly, to encourage national and local land-use strategies to minimize the occurrence of conflict situations and, secondly, to ensure that in areas where humans and elephants do overlap, that people derive tangible benefits from their presence. Land-use plans developed by relevant stakeholders (farmers and local governments) can reduce conflict and help to ensure the local community activities are restricted to those that are compatible with elephants. Some conservationists (Barnes, 1996; Hoare, 1995; Naughton-Treves, 1997) suggest that strategies such as game ranching and ecotourism are more compatible with elephant conservation than agriculture and can provide tangible benefits to people who share the land with elephants. Despite this apparent wide support by many conservationists, the success of a joint strategy involving ecotourism with other strategies attempted before in alleviating human-elephant conflict has rarely been tested. One such an area is Mwaluganje elephant sanctuary (MES) in Kwale district of Kenya. In MES, fences combined with establishment of ecotourism as an alternative economic land-use option have been tried in the last ten years as a HEC mitigation strategy in the area. While this community-based approach is a noble shift from the traditional approaches involving single application of HEC mitigation strategies such as translocation and fencing, no systematic work has been done to establish the impact of the sanctuary's HEC mitigation approach on the local community. It is against this background that this study was conceived.

Study objectives

The overall aim of the study was to determine the influence of the Mwaluganje elephant sanctuary (MES) on the local community. Specific objectives were:

1. To analyze the local communities attitudes and practices (e.g. agriculture and other livelihood activities) in relation to the MES.
2. To analyze the impact of MES ecotourism activity on the communities' attitudes and economic needs.
3. To analyze the effectiveness of the sanctuary fence in reducing human-elephant conflict in the area.

Study area description

The Mwaluganje Elephant Sanctuary (Fig 1) is located in Kwale district in the Coast Province of Kenya, stretching from 39° 25′ and 39° 30′ East and from 4° 03′ and 4° 10′ South (Fig 1). It is 36 km^2 in size. The sanctuary together with the Shimba Hills National Reserve form the Shimba Hills ecosystem but all ecologically situated in entirely different settings. While the Reserve rests entirely on part of a coastal plateau that rises up to an altitude of 450 m above sea level at a distance of 15 km from the Indian Ocean (Schmidt, 1991), the sanctuary lies below the plateau's escarpment on the Northern side. The entire Shimba Hills ecosystem is 250 km^2.

The climatic condition of Shimba Hills is humid semi-hot equatorial with an average temperature of 23.7°C and 1150 mm annual rainfall which is confined to the 'long rains' between April and July and the 'short rains between October and December (Jatzold & Schmidt, 1993). The months of January and February are considered the hottest while July and August are the coldest months. In addition to the rainfall, a considerable amount of precipitation occurs in the form of fog and dewfall (Schmidt, 1991). Due to its location on the leeward side of the plateau, the sanctuary receives relatively lower amount of rain than the reserve on average (Davies and Bennun, 1993).

While the southern half of sanctuary is characterized by bush/scrubland on the higher grounds, the northern half is comprised of the Mwaluganje Forest Reserve characterized by a mosaic of evergreen dry lowland forest cover. The African elephant (*Loxodonta africana)* is the dominant large mammal species in the Shimba Hill ecosystem. Other animal species found in the sanctuary include buffalo, impala warthog and a variety of birdlife, reptiles and invertebrates.

Apart from the rich biological importance, MES also contains a small patch of a sacred indigenous forest (popularly referred to as *Kaya* Mtae) that holds high cultural significance to the local Mijikenda people. The Mijikenda people traditionally used this forest together with others within the coast region for religious and spiritual rituals (Blackett, 1994). Despite the cessation of its use following the formation of the sanctuary, the sacred value associated with it has contributed to its historical preservation and continues to endow forest values to the

local community (Kahumbu, 2002). Moreover, it still retains the historical significance as a sacred place where the locals can identify with the Mijikenda ancestry. Currently, this *kaya* is part of the attractive sceneries forming the base for the sanctuary's ecotourism enterprise.

MES is entirely enclosed by a 24 km electric fence except a big section in Godoni cliff (Fig. 1). Basically the electric fence is built to function as a psychological barrier against elephants by giving short sharp but safe electric shocks to the elephants thus serving to deter them from crossing to farmers fields. Today the entire Shimba hills ecosystem, whose carrying capacity is 250 elephants (Kamanga, 1992), has up to approximately 650 elephants (Litoroh in press). Bull elephants predominate in the sanctuary while cow-calf family units are found mainly in the Reserve (Muir, 2000).

Administratively, MES is bordered by four sub-locations[1], namely Dumbule, Kibandaongo, Gandini and Golini, all characterized by settled agriculture. Population within these four sub-locations is estimated at 30, 237 people. Golini sub-location has the highest population density of 194 persons/km^2. This is due to the high agricultural potential and the high level of infrastructural development in this sub-location. The rest of the sub-locations are sparsely populated with Dumbule having the lowest population density of 86 persons/km^2 (Central Bureau of statistics, 1999). The main subsistence crops cultivated include cassava, maize, coconut, cashew nut, bananas, peas, pawpaw, oranges vegetables for subsistence and trade. Use of agricultural inputs is low. Both Dumbule and Gandini are rangelands and have less potential agriculturally but have the potential for ranching and general livestock husbandry (Kwale District Development plan, 2002). Those community residents who are members of the sanctuary are entitled to extra source of income mainly from its ecotourism enterprise.

Formation and management of the Mwaluganje Elephant Sanctuary

The process leading to the formation of MES (fig 1) was initiated in 1991 when Kenya Wildlife Service (KWS), the government agency in charge of conserving and managing wildlife resources in Kenya, proposed to the Kwale County Council that the land between the Mwaluganje Forest Reserve and the Shimba Hills National Reserve be declared a conservation area. The move was prompted by increased cultivation along Manolo River valley, resulting in intense human-elephant conflict (HEC) as elephants moved between the two forests. Cultivation on the Godoni Cliff (east of Manolo river) also posed an environmental problem due to severe soil erosion and silting of the Pemba River. The issue of declaring Golini -Mwaluganje a conservation area was, however, complicated by the existing land tenure arrangements in the valley. While Mwaluganje area (west of Manolo river) was held in trust by the Kwale county council, Godoni (east of Manolo River) had been adjudicated and individual title deeds issued (Anon 1991 in Kiiru, 1995b).

In the late 1980s and early 1990s, the Kenya Wildlife Service together with a few European settlers and affluent local people settled on the Godoni cliff started a process aimed at persuading the local people to give up their land for conservation. Recognising that human-elephant conflict was a major problem in the area, Eden wildlife Trust, a local non-governmental conservation organization, provided funds for installation of a 4 km electric

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[1] The second lowest administrative unit in the Kenya government system

fence in Mwaluganje area. The local people who owned land between the river and the proposed fence line were provided with building materials and asked to seek alternative land for settlement. Farmers cultivating the Godoni cliff had alternative land in Golini area and thus the relocation process did not affect them (Kiiru, 1995b).

Following the erection of the fence, the amount of elephant crop raiding reduced in the adjacent farmlands although elephants walked around the end of the fence line and entered farmlands. Recognizing this and continued crop raiding in the north and east of Mwaluganje forest, a further extension of the fence was made surrounding Mwaluganje Forest Reserve up to the northeast end of the Godoni cliff. At the time of fencing, the interest of the people in the Mwaluganje area were represented by members of a committee that had been elected to oversee community participation in the fencing project (Kiiru, 1995b). Extending the fence to cover half of the Godoni cliff was part of this second fence extension plan since elephants were also found to climb the cliff on the less steep sides and get into farmlands. However, KWS fencing efforts was frustrated by disputes over where the fence should pass between some families which had become MES members and a few other who were not willing to join but had land within the proposed sanctuary boundary on the cliff (G. Amboga, pers. Comm.). This had led to an estimate of 4km out of the total area earmarked for fencing in this area remain unfenced.

The MES was eventually formed in 1993 after a series of meetings between KWS, landowners in the proposed corridor, local administrators, politicians and the Coast Development Authority. The objectives of the project were to mitigate serious human-elephant conflict in the area and generate financial benefits through ecotourism for the landowners while availing the area as a dispersal area for elephants from Shimba Hills National Reserve (fig 1) and control soil erosion prompted by the over-cultivation along the Manolo River and the Godoni cliff (Kiiru, 1995b).

In 1994, the Kwale District Warden forwarded a formal proposal to register a limited liability company, Golini-Mwaluganje community conservation limited to run MES (Anon 1991 in Kiiru, 1995b). Following its official opening in 1995, today MES operates under this trade name as a company. Since the number of shares held by each member was based on the acreage legally held by the individual, only those landowners with title deeds were eligible to join the company. Mwaluganje landowners were thus not eligible. However, they signed up with the KWS community officer to indicate interest in participation in the company activities. The Kwale county council initiated land adjudication process in the area to issue title deeds to these landowners. The process was still on at the time of this study. In the company Memorandum of Association (MES, 1994), members were required to give legal right of vacant possession of their parcel of land to the company that they would not dispose off the parcel of land without the express and written consent of the company.

A number of tourist facilities have been built since the official opening of the sanctuary in 1995. By the time of the study, three gates had been built to give access to the sanctuary. Two of them have ticketing offices. Game viewing road circuits have been constructed and a tourist camp with a 40-bed capacity built to provide accommodation for overnight visitors. The camp owner manages the road network. The major sources of income for the sanctuary are gate entry fee and sales from an elephant dung project that has not yet been fully developed. Tourism has developed mainly with private sector involvement. A private

hotelier based in Mombasa owns and manages the camp while much of the funding for the gates and roads development was donated by Eden wildlife trust, USAID and KWS. The East African Wildlife Society jointly with the Core-Pact, both local conservation NGOs, developed a marketing plan for the sanctuary in 2000.

All monetary benefits and job opportunities from MES go to members only. The payment of revenue benefits to members is done yearly only to those people whose land has been adjudicated and title deed issued. The number of shares a member owns determines the amount of revenue to gets per year. One share is taken to be equivalent to one acre or any part thereof according to MES Memorandum of Association (MES, 1994).

Organizations involved in the running of MES have been going down over the years. Today MES members manage most of the sanctuary activities comprising of the ecotourism enterprise. The Government agencies involved are the KWS and the Forest Department. KWS participation has been directed at advising on wildlife policy issues and problem animal control in the area whereas the Forest Department manages the Mwaluganje Forest Reserve.

Methodology

Survey data was collected between January and June 2003 in the four sub-locations (Dumbule, Kibandaongo, Gandini and Golini) that border Mwaluganje elephant sanctuary. Each of these sub-locations was referred to as a 'survey site' during the study. A mix of data collection methods was used.

Questionnaire administered interviews

Data on farmers' sources of income, perceptions of elephant conservation in the area, ecotourism benefits and current problems with crop raiding by elephants was collected using a semi-structured questionnaire. The sample frame was limited to the area within a radius of three km from the MES boundary. This is because an initial pilot survey of the area around MES showed that areas that lay beyond 3 km provided limited information especially on issues related to the sanctuary. Distances were approximated from Shimba Hills Ecosystem Map. Using list obtained from MES manager and sub-location chairmen for members and non-members respectively, stratified sampling was employed to ensure a representative proportion of both MES members and non-members from each sub-location. This was necessary for comparisons of views between the two demographic categories and sites. This procedure gave 44 households for interview from each sub-location resulting in an overall sample of 176 respondents.

Two research assistants conversant with the local dialect were recruited to help administer the questionnaire. They were trained for two days prior to administration of the questionnaire. The questionnaire was pre-tested with the research assistants prior to administration. This was done so as to determine if the questions were understood and obtained the information needed in line with the study objectives. As a result, some questions were deleted and some modified to improve their clarity. A few additional

questions were made to the final questionnaire (see Apex I) to address issues raised by the respondents during the pre-testing but not captured in the questionnaire. The pre-testing also gave an idea of how long the interviews would take in the whole exercise. The final questionnaire was administered to the household head or the most senior member of the househead present. Research assistant were instructed to avoid the gathering of neighbours and kins during the interview time. This was made to avoid influence on the respondent's views.

Semi-structured interviews and group discussions

To complement the quantitative data collected from questionnaire interviews, informal interviews (semi- structured) and group discussions with key informants from MES management, SHNR wildlife officers, and community leaders and community members were also conducted. Those interviewed from MES were the MES manager and directors while from KWS was the warden. Key informants interviewed from the community were village chairmen and school primary school teachers some of whom were MES members while others were not.

MES Fence survey

The MES electric fence was tested for overall effectiveness from February to June. Data collection was made in three separate sections based on the existence of three stretches under which the entire fence is managed. These include Kibaoni stretch, which starts from Marere bridge extending a length of 8km in Dumbule, Milenane stretch which spans 7km in Kibandaongo and Black hall stretch in Gandini which span an area of 9km (fig. 1). In length, the three fence stretches give a total of 24 km for the whole fence. The study of the Black hall stretch included a 1.5 km extension in Golini as they had all been managed as one stretch. Using a fence survey form (See Apex II) designed during the study, data on the fence design, the type of damage inflicted on the fence by the elephants and daily voltage readings was collected. The MES fence team was asked to assist in collecting the data. Each completed form was returned to the researcher at the end of each month.

Transect walks and personal observations

Field data on agricultural land-use attributes of areas the surrounding of MES and verification of existing traditional efforts in protecting crop raids from wildlife damage were measured through transect walks and personal observations. Two transect walks spaced 100m apart each measuring 300m in width and running 4km alongside the fence line were done on each survey site. These were necessary for determining the land-use activities around MES and the most affected farming areas around the sanctuary. All sites covered by the fence were visited throughout the study period to make personal observation field notes on condition of the fence.

Review of MES reports and records and other literature.

Both unpublished and published statistical and research reports about MES and Shimba hills ecosystem were reviewed for data on MES activities; ecotourism benefits, forms and their sharing mechanism and trends on HEC incidents in the area over years.

Results

Demographic variables

A total of 176 respondents were interviewed. Out of this, one hundred and fourteen (64.8%) were men while sixty-two (35.2%) were women. The age of the respondents ranged from 20-72 years with the median age being 45 years. Most of the respondents interviewed were household heads. The Duruma was the dominant ethnic group constituting 50% of the entire survey sample. The Digo tribe constituted 38.6% of the sample, 9.7% were Giriama and 1.7% were minority tribes consisting of Kamba and white settlers.

Majority of the respondents (51.7%, n= 176) had received no schooling (illiterate), while 35.2% had completed primary education and 11.4% had received secondary education. Only 1.7% had been to middle level colleges and none had been to university.

On household economy, the survey indicated that majority of the households (56.3%) depend on mixed farming as their main source of income. Crop farming was identified to be the second source of income accounting for 46.6% of the respondents after mixed farming while business enterprises followed accounting for 1.1% of the respondents (See Apex III for respondents demographic data).

Community perception towards the elephants and the sanctuary.

The survey on community attitude towards elephants and MES revealed mixed results. Overall, members were found to be positive while the non-members were negative. Respondents' attitude towards elephants and MES was first measured using their responses to the key question 'Has Mwaluganje Elephant Sanctuary benefited the people living around it?' Responses to this question didn't show any distinct results from which clear conclusions could be drawn (Table 1). A total of 56.8% (N= 176) of the members were positive that MES had benefited the community around it as opposed to 61.4 % of all respondents who disputed that the sanctuary had brought any benefits. In contrast, an overwhelming majority (79.6%) of non-members said Mwaluganje had not benefited the community.

Asked to rank the benefits they were getting from the sanctuary, respondents ranked ecotourism revenue the highest with an average mean score of 3.4 ± 1.2, while employment came second (3.2 ± 1.1) followed by environmental protection with a mean ranking score of 3.0 ± 1.4.

To clearly infer the respondents' attitude, factorial design ANOVA was used to determine whether respondents' characteristics had any effect on their responses. In this analysis, I tested if factors such as respondent's site, education, membership, employment, farm size and distance from MES fence boundary which might account for survey response had any significant effect on the mean ranking of ecotourism revenue as the key benefit to the community in the area. The use of factorial design ANOVA enabled me to simultaneously include all these factors to understand respondents' attitude. Results revealed that membership had significant effect on the mean ranking of ecotourism benefits revenue as the key benefit accruing to the community from the sanctuary ($p= 0.023$) (Table 2). This confirmed the positive attitude by majority of the members contrary to the overwhelming negative response (79.6%) by the non-members.

Members pointed out that the sanctuary had benefited them financially and had created jobs for some of them despite a persistent crop-raiding problem by elephants. On the contrary, the 79.6 % non-members who reported MES not to have benefited them were opposed to the elephants and the sanctuary. A bursary scheme provided by a Good Samaritan from the community to sponsor bright primary students to pursue secondary education was mentioned by only four members and two non-members. Students were sponsored for only one term in a year and parents had to pay for the rest of year's fees.

Impact of MES ecotourism enterprise on the community economic livelihood

To gauge the impact of the ecotourism enterprise on the members (since they were the main beneficiaries) members were asked to rate the extent to which they thought the ecotourism business had impacted on their economic livelihood. About 41.8% (n= 87) of the respondents perceived the project to have benefited them much while 56.1% reported that it had somewhat helped them. Only 2.1% of the respondents said they had not yet benefited because their farms were still undergoing adjudication. A total of 71 % of those who said to have somewhat benefited owned less that seven shares in MES. The common cited benefits from the ecotourism enterprise were the monetary gains paid from the annual revenue collections as identified by 88.1% of the responses (n= 86). Job opportunities were mentioned the second as some of the members were working in MES.

Asked whether there was any problem with the benefits they were getting, a substantial percentage (62.7%) expressed reservations. They argued that although many people were benefiting, the revenue benefits were raising major concern that payments per share were low and the trends were going down compared to the initial years of compensation in 1997 and 2000. These arguments appear to be contrary according to statistical analysis of yearly MES tourism returns and payments made to members over the years (Fig.2).

According to MES financial records, members were paid KShs 1000/share (US $ 15 at 1997 exchange rate) in 1997, the first year of revenue payment, which rose to KShs 1500/share (US $ 20) in 2000 at that year's exchange rate. For the other two successive years (2001 and 2002), the distribution indicates an increasing trend (fig.2). Benefits were not paid in 1998 and 1999 as tourist numbers and overall collections were lower than expected, due to El

Nino rains which severely limited access to the sanctuary, particularly by washing Marere bridge (fig. 1) which connects the sanctuary to the main road from Kwale town.

Analysis on MES overall expenditure rates to capture their impact on total yearly revenue paid to members was not possible for all the years since its launching in 1995 as records were not available. However, results on two years analysis revealed little effect of MES expenditure on total payment to members in 2001 and 2002. In 2002, 51.1% of the revenue went to members. Out of the rest, 24.1 % went to staff salaries, 9.3% to office and general operations, 14.6 % to fence maintenance and 0.9 % on vehicle running and maintenance costs. The only significant increase on expenditure rates over the two years that seemed to affect the overall yearly payments to members was on fence maintenance, which increased from a low of 9.7% the previous year to 14.6 %. This affected the total yearly payments for members from 54.7% in 2001 to 51.1% in 2002.

Consistent with figure 2, visitor numbers in MES have experienced dramatic changes since its inception. A marked decline of tourist numbers visiting MES was recorded from a high of 2629 visitors in 1996 to a low of 1793 in 1997. However, visitation numbers started rising again in the successive years as from 1998, registering 350% increase in 2000. The highest number of tourist that had ever been recorded in the sanctuary was 9044 in 2001, which dropped by 14% in 2002. Most of the foreign tourists come from Europe, mainly German, Italy and France followed by Americans. Resident tourists have accounted for 15-22 % of the visitors to the sanctuary over the years.

Impact of MES ecotourism on members economic livelihood was also measured based on its potential for job creation. To run its activities and maintain operation facilities, MES has been able to employ 18 members of staff working in different jobs according to its official records. All are drawn from the local community. The workers include a sanctuary manager, one clerical officer, 8 scouts, 7 fence attendants and a driver. Ten other local people have been employed at the Mwaluganje Elephant Camp, the only visitor-eating place inside the sanctuary. The sanctuary also employs up to 6 other local people each year as casuals to maintain the fence.

Use of MES revenue benefits by members

During the household survey members indicated that though MES had somewhat tried to demonstrate that the locals could benefit from the existence of wildlife around them, payment of enough benefits to meet not only basic domestic needs but also community development needs was crucial. Many respondents in both household survey and informal interviews raised this issue noting that what they were getting was just enough to buy domestic food, clothing and pay primary school fees (fig.3). Asked on how they were spending their revenue benefits during the questionnaire survey, majority (51.9%) use it for food and clothing, 24.8% for Primary school fees and 17.1% for buying livestock mainly goats to cushion them against hunger in times of crop failure. Only 6.2% got enough especially those with many shares to be able to invest in small-scale businesses.

In informal interviews, majority of the members especially the elite and community leaders indicated that they expected more revenue benefits in future to enable them to take their

children to colleges and fund community basic infrastructure development in addition to creating more job opportunities.

Other MES management issues raised by members

On predicaments facing the management of MES in its efforts to generate more benefits, a considerable proportion of members (63.5%, n= 87) expressed the concern that proper communication between the management and the members was lacking. This is particularly on the part of project decision-making concerning implementation of new projects. For instance, a bee-keeping project that had just been conceived prior to the start of the study was found to be a major cause of the members complains. It was established that part of the money used to purchase the beehives came from the sanctuary from the sanctuary earnings for that year (J. Mwadudu, Pers. Comm.). A significant number of the members (67.1%, n= 88) pointed out that they were not consulted prior to the adoption and implementation of the project and wondered what would happen to their money if the project didn't succeed. The elite members were especially critical of this neglect.

The elephant problem: Seasonality, crops preferred, severity and extent

The survey indicated crop damage was still highly perceived as a serious problem affecting farmers living close to the sanctuary (Table 3). About 88.6% of those complaining about elephant crop raiding came from Dumbule, 84.1% from Kibandaongo, 86.6% from Gandini and 81.4% from Golini.
Further, to capture the extent of the of the elephant crop raiding problem in the different survey sites, analysis was done on crop most preferred and damaged by elephants, and had resulted in farmers giving up planting some of them. Farmers observed that elephant impact in farms peaked in the rain seasons (April- July and October- December) with the most preferred crops being cassava, maize and coconut although elephants were said to consume almost all crops grown. Other crops preferred by the elephants were bananas, pumpkins and peas, pawpaw and oranges.

About 35.1% (n= 44) of farmers in Dumbule indicated that they had stopped planting cassava and coconut while 28.6% (n= 44) from Kibandaongo had stopped planting cassava (Table 4). The entire survey indicated that 63.7% (n= 171) of those who had stopped planting one or two crops (mainly cassava and coconut) due to elephant crop raiding came from Dumbule and Kibandaongo sub-locations. Asked why they had stopped planting these crops, farmers said that they had stopped planting these crops as the elephants always depredated the crops before they were mature for harvesting. Maize followed in the list of the most preferred and affected crops by elephants. However, farmers said they kept planting the crop since they had no other source of food after cassava and coconut, which were highly affected by elephants. Three farmers near one of the key elephant crossing point (Fig.1) in Dumbule reported to have given up planting in their farms and rented farming land elsewhere as they never made any harvests due to elephant crop raiding. Moreover, farmers particularly in Dumbule and Kibandaongo were worried by an unprecedented new

taste of cashew nut tree felling and branch breaking by elephants. Personal field observations confirmed these crop damages.

The survey showed that most of those who had stopped planting some crops due to elephant problem were within 1 km from the sanctuary boundary with those near the key elephant crossing points being the most affected. Farmers in more than 1km from MES fence rarely mentioned to have stopped planting any crop. Information from informal interviews mainly from respondents close to the fence in Dumbule and Kibandaongo revealed that male bulls were seen around the fence in the evening before sunset coming out to raid crops at night. This is consistent with personal observations made in the field. During the day, elephants were rarely seen anywhere near the sanctuary fence.

On crop harvest rates, 65.5% (n= 171) of the respondents said that they were not satisfied with the yields of agricultural produce from their farms attributing this to different causes. A significant proportion (64.8%) of them identified elephants as the main cause of the reduced yields. Only 16.1% identified elephants jointly with rainfall failure as the cause. A common observation made during the household survey and in informal discussions with farmers was that the non-members, in particular, didn't care getting any monetary or any other form of benefit from the sanctuary so long as elephants were kept away from their farms.

Apart from crop damage by elephants, farmers also reported other elephant associated problems they experienced (Table 5). A total of 46% (n= 176) mentioned restricted movement by elephants as the second most serious problem after crop raiding. These reports were more common in Dumbule and Kibandaongo than in Gandini and Golini. The problem of school children going to school late was reported more as a problem in Dumbule (25%, n = 43) than in the rest of the sites. Other elephant problems include environmental damage, which was reported as a problem in Dumbule only, accounting for 4.1% (n = 43) of the responses. Farmers believed the elephant population had uncontrollably gone high over the years compared to the relatively small size of the sanctuary and that is why they had become problematic to the extent of destroying the sanctuary fence, raiding their crops and disrupting people's social life. Majority (67.7%, n= 176) of respondents said the MES fence was no longer deterring elephants with an overwhelming 74.2 % of them attributing the fence ineffectiveness to low voltage as a result of using solar power instead of using power from the national grid. Majority of the farmers expressed concern over what would happen to the crop farming if the elephant population was not controlled.

When asked whether they reported complains to Kenya wildlife Services whenever elephants raided their crops, 68.8% of the respondents said they didn't report incidents. This is because, firstly, there was no compensation, secondly, there would be no action from KWS, and thirdly, the KWS office in Kwale town was too far to walk there to report. As much as 46.2% and 38.5% (n= 26) of those who complained that KWS office was far from their reach came from Kibandaongo and Gandini respectively. Some of those who reported their cases to KWS said that ranger's response was rare and whenever it occurred they always showed up long after the elephants had raided farms and left.

Human deaths and injury

Human killing and injury by elephants were also mentioned as a problem by 31% (n= 176) of the respondents during the household survey. According to the official records in Kenya wildlife Service, four people had been killed by elephants in the entire survey area in the period between 1989 and 1993 prior to the formation of MES. Only one human death caused by elephant had been recorded in the same area since the time of the sanctuary establishment in 1993 up to 2001 compared to deaths caused by other wild animals. Rapid hyena was responsible for two human deaths in 2000 in Golini. The one human death caused by elephant that took place in Dumbule in 1999 seemed to be still fresh in the respondents' memory for this is what they commonly mentioned according to observations made during the household survey and in informal discussions.

Farmers coping strategies against elephant damage

From household interview supported by personal observation in the field, farmers were found to employ a variety of traditional techniques to minimize elephant crop raiding (Table 6). The most popular technique applied by the farmers was lighting fires in the farm at night to guard crops. Majority of the respondents (77.3%, n= 176) said it was their most effective measure they relied on but elephants were getting habituated to it. It has also the limitation that it had to be kept burning the whole night and the attendant would not sleep.

Making noise was the second most used technique accounting for 69.3%. This technique involves beating drums and banging of metal tins to frighten the elephants off. However, farmers complained that these methods were no longer effective since elephants had got used to them. They said that some habitual elephants whenever found raiding crops did not even react to noise but instead sometimes continued eating crops.
Torchlight was applied by 38.1% of the respondents while throwing stones at crop-raiding elephants was used by 15.1%. On stoning, however, farmers said it had little effect because in some cases it got the elephant agitated making them charge at them.

It was noted during both household survey and informal discussions that farmers didn't harm the elephants when they got into their farms. Because of the severity of elephant problem in Dumbule and Kibandaongo, the survey revealed that the farmers in these areas were in the process of forming a community committee to be in charge of environmental issues particularly voicing elephant related problems to KWS as they viewed individual reporting had not bore any positive impact.

Other wildlife related problems

Farmers were also found to be affected by other wild animals apart from elephants according to the household survey (Table 7). Bush pig and the yellow baboons were reported by 94.2% and 74% of the respondents respectively to be the most destructive of the small-sized wild animals from the sanctuary affecting farmers. Other small-sized animals mentioned but less severe include warthog and monkeys. The bush pig was considered more destructive than the yellow baboon as they destroyed crops at night when farmers were

asleep unlike the yellow baboons. The latter were said to raid during daytime and are therefore easier to deter. However, farmers said they feared that soon the baboons will be equally annoying as the bush pig because their population had dramatically gone high through out the entire study area over the last few years. Moreover, baboons were said to be becoming present near the farms throughout the year, were hard to fence out, were clever in avoiding detection by farmers and caused damage to all stages of most crops including germinating seeds which were not affected by bush pigs and elephants. Personal field observations confirmed these claims to be true. There is no quantitative information of the relative amount of damage incurred by the various species due to the short time study period. Nevertheless, farmers called for the population to be controlled and the remaining population be kept out of their farms by modifying the MES fence design to also restrict small-sized animals.

Comparing the severity of damage between elephants and the small-sized animals, however, an overwhelming majority (83.4%) of the respondents said that the small-sized animals were less severe in terms of the damage they incurred on the crop compared to the elephants. To explain the difference in severity, farmers said the small-sized animal were selective in the crop they ate and were easy to control unlike the elephants which ate almost all crops grown and was hard to control once they had gotten into the farm.

Farmers responses on alternative conflict mitigation measures

Majority of the respondents were eager to suggest alternative measures to mitigate the conflict with elephants (Table 8). A considerable proportion (76.4%) of the respondents said the fence should be made strong and active enough to keep elephants out of farmer's fields while 62.1% said the excess elephant population should be translocated to other areas to reduce the population in MES, as it was too small for them. Killing of 'habitual crop raiders and fence breakers' was suggested by 36.8% of the respondents (n= 174) whereas 54% suggested increased ranger patrols. Total percentages are more that 100% because individual farmers suggested more than one option.

Respondents particularly from Kibandaongo, Gandini and Golini suggested other alternative control measures that appeared to be site specific. In Kibandaongo and Gandini, 63.6% and 47.7% respectively said ranger outposts should be build in their areas for quick response to elephant problems whenever they came out of the sanctuary. Only 13.2% suggested elephants to be removed from MES altogether to other areas. These were mainly non-members.

With the unfenced portion of the sanctuary in Golini, an overwhelming majority (77.3%) of the respondents in the area called for KWS to fence it similarly to what they had done on the other sides of MES. However, it was observed in both informal and household survey that there had been a long history of controversy particularly on where the fence should pass in this area. It was noted that some Golini farmers who had declined from joining MES owned farms inside the proposed Golini fence boundary and wanted to continue farming. These farms were interspersed in a form of mosaic with other farms belonging to farmers who were already MES members and hence the controversy on where to erect the fence. Those who were calling for KWS to build the fence consisted of Golini residents who are MES members and others who didn't own farm in the disputed area.

High anticipation for the HEC to go down by the farmers following construction of an effective fence was seen in the farmers willingness to contribute financially to buy a transformer for the fence to be connected and powered by the main power supply from the national grid since they didn't trust the solar panels that the management was using to power the fence. An overwhelming majority (71.4%) of the members said they were willing contribute a certain percentage of their yearly earnings to be used in constructing an effective fence as they said the current one was not working to deter elephants.

On compensation for crops damaged by elephants, a significant majority (80.1%) of the respondents called for the new government to review the compensation scheme, which currently covers human death and injury only, to also cover crop damage and damages to property. It was often observed in both informal discussions and in the household survey that many of the respondents appeared to trust the feasibility of fully operational compensation scheme if it was put in place. They often quoted the existence of the new government, following the 2002 general elections, singling that it was committed to solving the myriad of problems afflicting Kenyans. Farmers took strong exception to lack of compensation for crop damage and noted that they don't grow crops to aid elephants foraging.

Assessing the effectiveness of MES fence in HEC mitigation

Technicalities of MES fence design

The MES fence is solar powered with each of the three stretches having its on solar panels and energizer house. The fence line has three wire strands in Gandini to four in both Kibaoni and Milenane where two are live in all stretches. It is 1.8 ± 0.29 m in height. The design has wooden line posts varying from 14 - 22 cm in diameter. On average, the distance between posts was found to be 16.79 ± 2.14m. Intervals created between posts that had been broken and never replaced varied between 30 to 40 m. The wire strands were observed to be increasingly sagged at these points.

Forms and extent of fence damage

Elephants were found to inflict various forms of damage on MES fence line. These included fence post damage, wire cutting, challenging posts and wire stripping from the post. Post were recorded as damaged if found broken or pushed over completely while post challenged involved those posts that elephants tried to push over but failed to knock it over completely. Wire stripped from posts were those not cut but had been plugged off from the post by the elephant. Statistical analysis found these damages were incurred with varying frequencies (fig.1). Fence posts damage was the worst recorded form of fence damage during the five months study period with an average of 12.3 damages/day on the whole 24 km fence. Wire cutting came second with 5.5 cuts/day on average. The ratio of damaged fence posts to wires cut was 1:2.2 indicating that elephants attacked and broke fence post more often than

wires. Wire stripping from posts was the least form of damage inflicted on the fence on average.

A comparison between the two worst forms of damage inflicted on the fence (post damage and wire cut) showed that, despite being the shortest stretch, Milenane stretch was the worst hit registering the highest fence posts damages and wire cuts in a kilometer per day (Table 9). On average, the month of February registered the highest breakages of post per kilometer per day in every stretch.

Fence effectiveness

For the analysis, the number of fence posts broken and wires cut by elephants were used as a direct indicator of fence effectiveness. The fence was inferred as ineffective if breakages occurred every week; medium effective if broken at least two times per month and effective for a single breakage in two months time. On average, the fence was found to be ineffective as all analysis results corresponded to the ineffective rating (table 9). None of the three fence stretches was found to be elephant proof as elephants broke each several time per week despite daily maintenance.

The daily voltage records showed high evening voltage reading averaging 8.1 ± 0.19 V compared to morning readings. This was as a result of repair work done in the fence during the day by the fence maintenance team. In order to determine to what extent the fence voltage deterred elephants from crop raiding in each stretch, correlations were done on daily evening voltage readings and the number of posts broken. Results indicated no correlations between the two variables (Kibaoni $r = -0.115$, P-Value $= 0.160$; Kibandaongo $r = 0.140$, P-Value $= 0.089$; Black hall $r = -0.105$, P-Value $= 0.200$). While the average distance recorded for the earthing wire in Kibaoni-Milenane stretches combined was 120.57 ± 21.83 m, Gandini recorded an astounding average interval of 150 ± 11.21m. The average earthing voltage readings taken every evening in the month of June in all stretches was 0.3KV.

Other factors influencing fence effectiveness

Although elephants damage were generally observed to be spread over the entire fence line, information from discussions with fence maintenance team indicated presence of major exit and entry points along the fence line. This were at Marere bridge; Mile Sita near Ngonzini Primary school; two points between Milenane and Mile Tisa and at the river crossing point in Gandini (Fig.1).

In places where the fence crossed ravines and streams, particularly in Milenane in Kibandaongo and the two-kilometer extension of Gandini stretch in Golini, it was observed that the lowest fence strand was too high leaving wide unfenced gaps under the fence. As a result elephants had established extra crossing points in some of the ravines that were wide open and easy to climb. Farmers near these points were among the most seriously affected by elephant crop raiding.

Discussion

Community attitude

Although elephant crop raiding is still perceived as a major problem by the community around MES, different segments of the community have different attitude towards the elephants and the sanctuary (Table 1). This attitude appears to be shaped mainly by the benefits from the sanctuary. While non-members view elephants and the sanctuary negatively, the members embraced them. The members' prevailing positive attitude is not something unusual given that they are benefiting from MES. The survey showed that they receive the ecotourism revenue and job opportunities accruing from MES. Studies by other authors elsewhere (Naughton-Treves, 2001; Infield, 1988) have shown that communities receiving benefits from the existence wildlife in their midst can improve their attitude and the ability to tolerate some level of conflict with wildlife. The experience presented by the MES members demonstrates the positive effect of realization of wildlife benefits on the attitude of local communities towards conservation and protected areas.

The non-members negative attitude appeared to be justified by several factors. Firstly, they experience a serious problem of crop raiding by elephants. Secondly, the government didn't compensate farmers for crops damaged by wildlife. Thirdly, they don't get any form of benefit but continue to bear the wrath of elephants crop raiding. Their negative support for MES conservation efforts concurs with a common suggestion amongst conservationists and development agencies that farmers facing crop and property loss from wildlife without any form of benefit accruing from the wildlife are less likely to support conservation efforts (Infield, 1988). The prevalence of the crop damage by elephants and the lack of any benefits to the non-member, which they see accruing to the members, could only serve to make them have mistrust in KWS and the whole MES conservation efforts as far as the mitigation of the conflict is concerned if not addressed.

Changing the negative attitude of the non-members will require incorporating them in the overall MES conservation efforts as part of the community affected by MES. Non-member respondents from all survey sites emphasized that they feel neglected by the MES management and the Kenya Wildlife Service in general considering that elephants continue raiding their farms while it is only the members who are benefiting from MES. Extending MES benefits to non-members, for instance, may be an option to improving their attitude. However, according to MES constitution (MES, 1994), MES operates as a company whose membership is based on land ownership in the sanctuary. This is a major obstacle that would face a management decision to extent revenue and job benefits to the non-member. Moreover, the extension may not be possible considering that the current benefits were little which had raised complains from majority of the members. The challenge remains for the government to create an enabling environment for people bearing the greatest costs of living near the sanctuary to get compensated and reduce the costs accruing to the farmers by keeping the elephants and other problem animals out of their farms. Adopting a more integrated approach that embraces combining community level small-scale projects well linked to conservation with individual compensation for crop losses may be a possible means of bringing benefits to non-members and improve their attitude. This has been found to be successful in Tanzania (Archabad 2000 in Naughton-Treves, 2001).

It should be considered, however, that the current Kenya Wildlife Act Cap 376 allows compensation for only human death and injury and so it would require changing such a policy for it to be applicable. On the other hand, decision on the type of community projects to be implemented should be based on the communities needs to win acceptance. The community bursary scheme mentioned by only five survey respondents appears to have had insignificant impact on the community because of the amount of short school time and few students it sponsored per year. This underscores the importance of creating economically viable projects whose benefits flow is sustainable. Creating such projects would require the KWS, MES management and the community work as a team in collaboration stakeholders to identify relevant and viable small scale for funding by Kenya Wildlife Service and other donor organizations. It is here where the current joint management plan for Shimba Hills in the process of development by KWS and MES should come to the fore as a means of collecting information into any integrated holistic framework that involve the non-members too in benefiting from MES.

Ecotourism impact on the community economic livelihood

The respondents' perception and understanding of the impact of the ecotourism enterprise was consistent with personal observations made during the study. Although all the ecotourism benefits went to the members it appears that majority of the members were not satisfied with the amount they were getting from the enterprise. Study results showed that a considerable proportion (56.1%) of the respondents perceived the enterprise to have only benefited 'somewhat' while the rest ranked it to have benefited them 'much' in the analysis scores. The prevailing dissatisfaction could be explained by a few factors. Firstly, while half of the total yearly collections have been spent to pay members over the years, figure 3 results show the revenue received at the individual level had been enough only to meet domestic needs but nothing to fund basic community development infrastructure. Secondly, the total number of shares that the payments were made to each year also led to low impact of the revenue. The payment of MES revenue benefits since the launching of the sanctuary in 1995 was made yearly to only those people whose land within the sanctuary had been surveyed and title deed issued. The MES land adjudication process was still on during the time of survey. This meant the number of shares had been increasing each year since1995 when the adjudication work in MES started resulting in reduction in the revenue amount paid per share (J. Mwadudu [MES Manager], Pers. Comm.).

In a land economic survey in Mwaluganje, Warinda (2000) found that the value of the sanctuary when put under conservation and the tourism potential fully exploited as an alternative land use was more than that from crop farming. He estimated the productivity of one acre to be US $14 per year if put under livestock production which compared to be more productive than crop farming. This estimation equaled the lowest paid amount per share since 1997 from the yearly ecotourism revenue (fig.2). Although the revenue payments were generally well above the threshold obtained by Warinda (2000) based on livestock production as the second best land-use option after ecotourism (fig.2), the dissatisfaction with the benefits by majority of the members is a major source of concern. This if not controlled may with time start affecting the members observed positive attitude and strong support for conservation in the area. The foundation of the Community Based Natural Resources and Management concept rests on the assumption that the community will be

more conservation oriented if they play a greater role in the management and substantial benefits accrue to them from the management of the local resources (Campbell, 1999; Bell, 1984; Verlag, 1995; Sibanda, 2001). The challenge for MES management remains to generate sufficient revenue to compensate its members. No one can otherwise deny them their intention, if they so wish, of making all the important land-use decision themselves even if it would mean reverting back to the same agriculture already proven to be poorly productive.

From the foregoing, however, MES appears not to have adequately developed its ecotourism base, which can still be done to generate enough revenue to meet the expectations of its members. The lack of a marketing officer and full implementation of its marketing plan (EAWLS, 2000) clearly explains this inadequacy. It is most likely that inadequate marketing has resulted to the observed few tourist inflows in MES (fig 2), which in turn has affected the total yearly collection from the ecotourism enterprise. To get more tourists and hence generate more revenue for the members, MES management would need to give immediate attention to marketing its ecotourism enterprise aggressively. A full time marketing officer would need to be hired to be in charge of the marketing it ecotourism products in that case.

Financial commitments were also identified to be affecting MES marketing activities. Since revenue payments began in 1997, MES had not been setting aside a substantial budget to market the ecotourism enterprise (J. Mwadudu, Pers. Comm.). While this had led to big percentage of the total yearly returns going to members, it had denied the ecotourism enterprise the opportunity to grow. Getting MES well known as a tourist destination will depend on the financial commitment made in marketing by the management. A balanced mechanism of sharing yearly ecotourism returns should be ensured to also provide allocations for crucial ecotourism development initiatives such as marketing and relevant staff recruitment. This must be qualified by noting that the tourism earnings and the job opportunities represent very important sources of income as agricultural production in the area is generally poor (Warinda, 2000) and many people are unemployed as found in this study. Since the budget allocations for marketing may not be enough to fund all associated activities given that MES is still young in its development and members feel dissatisfied with what they are being paid, additional donor support may be sought to cover its budget.

A study on Community Based Natural Resources Management (CBNRM) initiatives in Namibia (Barnes et al., 2002) found that conservancies with diversified ecotourism products were more immune to market tourism instability than those that relied on selling single products to their tourist clients. The high returns in the MES elephant dung project in its first year of business in 2001 (estimated at US $ 2800) demonstrates a high business potential if fully exploited. Full development of this project in addition to exploration of more avenues for income generation will be a great boost to the collections from gate entry fee. A bee keeping initiative conceived during this study is a welcome move towards this direction. The current sanctuary's marketing plan (EAWLS, 2000) also identifies more attraction sites and avenues that can be developed in Mwaluganje to attract more tourists and generate more revenue. The implementation of these is yet to be seen. The greater the rent (revenue) captured by the shareholders following their full implementation the greater will be the members incentive to tolerate and support conservation in MES in the long run. It should be noted that, however, every aspect of the tourism product diversification in MES will need to be well planned to ensure little conflict with conservation objectives. The current joint management plan for Shimba Hills under development should be able to guide the

development and control of new ecotourism diversification activities on its completion. The plan should identify areas for intensive and semi-intensive ecotourism related utilization and be marked as priority zones.

The survey found that while there is only one camp owned by a foreigner providing food and accommodation services to overnight tourists in MES, the little bed night fee charged on the investor goes to Forest department as the camp was located in MES Forest Reserve. The community has traditionally used this forest for religious and spiritual rituals (Blackett, 1994) and despite its current underutilization due to fear of elephants by the community, the sacred value associated contributed to its historical preservation (Kahumbu, 2002). Recognizing these roles that the community has played to conserve the forest, the bed night fee sharing arrangements should be eased to involve them.

The prevailing fear over dwindling revenue per share expressed by 62.7 % of the member respondents appeared to be contrary to statistical results of yearly MES tourism returns (fig 2). The perceived downward trend may be explained by the inconsistent mode of benefits payment. The study revealed that the payments for 2002, for instance, were paid in two separate times within the same year. This was contrary to the earlier mechanism of making payments in which revenue was paid once per year. Although this was in a process to implement a management decision to shift the annual payment dates to the end of the year when the demands for money by members was high (Mwadudu, Pers. comm.), it is likely that the impromptu splitting of one year payment into two reduced the amount received each time thus possibly creating the misplaced perception amongst some members that revenue paid were going low. Perceived mismanagement of community tourism revenue for personal gains in Uganda led to community members to mistrust park officials (Naughton-Treves, 2001). To avoid such a scenario, which may lead to suspicion and conflict between the management and the members on revenue shared in MES in future, any change from the officially agreed mechanism should be properly communicated to members prior to making payments.

Participation of members in the management of MES ecotourism activities

The survey showed that MES members manage most of the sanctuary activities comprising of the ecotourism enterprise. They man the tourists gate, collect and decide on how to spent the revenue and decide on new projects. On decision-making level, however, the survey results revealed that proper communication was lacking between the management and the members. In both household survey and informal discussions, members indicated that sometimes the management didn't consult the members before making major decisions affecting the ecotourism enterprise and so they had little influence over these decisions. The management, on the other hand, asserted that members were always informed prior to making key decisions. From these claims, it appears that there are divisions between the management and the members on these issues. These communication and decision making gaps, if not bridged, may culminate in creating a 'suspicious environment' resulting in a potential state of conflict between the management and the members that will only serve to frustrate their conservation efforts in the long run if not addressed. Holding occasional meetings and production of a monthly newsletter to update members on progress as well as

communicate new upcoming initiatives could help avoid a possible suspicion atmosphere. It will also help build trust in the management by the members.

The Mwaluganje elephant problem and options to mitigate the conflict

Despite the positive attitude amongst some community members associated with benefits accruing from the presence of elephants in MES, the survey showed elephant crop raiding to be still a serious problem affecting farmers (Table 3). This had also contributed to the non-members' negative attitude. It appears both Dumbule and Kibandaongo are the most highly affected sites by elephants as they had given up planting some crops although there was no difference in the perception of the problem in all sites (Kruskal-Wallis H = 3.49, P = 0.321). The possible causes of elephant crop raiding were not thoroughly studied as part of this study. A few factors, however, may be considered possible causes. Firstly, the high incidences of crop raiding peaking during the rain season when natural stocks elephant food is high suggest that elephants have developed a taste for maize and cassava, the main crops grown at this season. This also appears to confirm farmers' suggestions during survey interviews on elephant crop preferences.

Secondly, crop raiding may have been caused by increase in elephant population in response to increased protection. In Shimba hills ecosystem, data obtained from both indirect (dug count) and direct (aerial) counting techniques indicate an increasing trend of elephant population. Reuling et al (1992), Mwathe (1995), Litoroh (2002) and Litoroh (in press) counted 400, 454, 464 and 649 elephants respectively. These population estimates overshot the ecosystems carrying capacity estimated at 250 elephants (Kamanga, 1997). In a 1997 aerial count, Litoroh (2002) obtained an elephant density of 1.9 elephants per kilometer for the entire Shimba Hills ecosystem. The density for Mwaluganje was 6 elephants/km^2, which is probably one of the highest densities ever recorded (Litoroh 2002) although elephants are able to move freely between the reserve and the sanctuary. Very high elephant populations would of course be expected to cause a complete degradation of their habitat as observed in some parts of the sanctuary during this study and others contacted earlier (Omondi et al, 1994; Mwathe, 1995; Kiiru, 1995b; Litoroh, 2002). The result would be search for food elsewhere particularly outside which would in turn be expected to lead to increased incidences of crop raiding and hence conflict with human beings.

Managing the elephant population

To stem down the high level of human-elephant conflict in the area and ensure protection of biodiversity in the ecosystem, there is urgent need to consider reducing the current number of elephants and adaptive management of the population adopted in future. In good terrain and open country, KWS has commonly relied on translocation to manage wildlife populations (Litoroh, 2002). Rough terrain and forest cover, however, have presented special difficulties for translocation in Shimba hills ecosystem. Because of hilly nature of the landscape and the high cost of translocation, for instance, KWS managed to translocate only thirty elephants to Tsavo East National Park (Muir, 2000). This was only a sixth of the recommended 200 elephants for translocation following 1997 census (Litoroh, 2002) suggesting the impact of the translocation on the elephant density is likely to have been insignificant.

Although controlled shooting has been applied as a conflict reduction measure in Shimba ecosystem, one would obviously expect its impact on the conflict situation to have been insignificant given the high elephant population. According to the KWS records, for instance, only 17 elephants were shot on control between 1994 and 1999 in the entire Shimba hills ecosystem. Secondly, this measure suffers inherent weaknesses in that it is only applied on special cases when 'rogue elephants' identified to threaten human life and property are destroyed (KWS, 1990). Moreover, while it has been applied as a quick fix method, the survey showed the reliability on controlled shooting in Shimba hills ecosystem to have had other limitations. The KWS problem animal control team doesn't have prior knowledge of the main culprits and many times they are forced to rely on farmers for information. This impairs the chances of identifying of the real culprits. Research elsewhere has shown that the frequently practiced removal of supposedly identified individual culprit elephants by wildlife managers has apparently repeatedly failed to produce any meaningful reduction in conflict incidences (Hoare, 2001). On application of barriers to contain problem animals, arguably, the effectiveness of the fence (discussed later) will also continue being low given the high elephant population which appears to be partly of the causes of the conflict intensity.

It clearly appears that no single management option will successfully deal with all problem elephants and conflict situations in Shimba hills given the high elephant population. The conflict can only be reduced or minimized but probably never solved if humans and elephants are to co-exist. Despite the limitations that have hindered massive translocations in Shimba hills in the past (Muir, 2000), translocation would still be the handiest urgent measure to reduce the current high elephant population. In the long term, however, it appears translocation as an elephant population control measure in Shimba hills is sufficiently unlikely in handling large numbers in view of its high associated costs. One option to make it sustainable and sufficient in handling large numbers would be to augment it with by other measures such as culling to maintain the population within the recommended carrying capacity in the long-term. The application of culling would not only reduce the elephant population but also provide benefits in terms of meat to the surrounding community thus serving as an incentive to conserve. It should be considered, however, the current wildlife Act Cap 376 prohibits culling and so it would require changing such a policy for it to be applicable. As elephants are a strong magnate for tourism not only in Mwaluganje but also in the Shimba Hills National Reserve, the political and economic implication of its applications should be judiciously considered before it is adopted. The controlled shooting programme should also be reviewed from its current 'vague form of application' to a well formalized problem animal control tool. This will help to keep the number of habitual fence breakers and crop raiders low

The implementation of the culling programme and problem animal shooting as the study suggests should be guided by the results from a continuous well designed problem elephant monitoring and reporting programme which should be put in place as a basis for decision making. It was noted during the survey that this kind of programme in the entire Shimba Hills is inadequate for monitoring of problem elephants is largely limited to farmers reporting incidences to KWS whenever they want appropriate action to be taken. For effectiveness, the designed programme should involve the community, MES management and KWS working as a team. During field discussions, several farmers appeared to be

knowledgeable on the identity of habitual fence breakers and crop raiders. Such community knowledge would be highly valuable in the problem elephant monitoring programme, which underscores full involvement of the community. Culling programmes, however, have been observed to cause disruption of elephant social structure and aggressive behaviour towards humans (Moss, 1988) and therefore they should be carefully done.

Other measures for population control that may have an indirect positive on the conflict situation in Mwaluganje would be the implementation of elephant fertility control, an immunocontraception method suggested by earlier authors (Muir, 2000; Litoroh, 2002). This would be handy in stabilizing the ecosystems elephant population around its carrying capacity. However, its implementation would require to be tested first for any possible negative effects on the population.

Land use activity around MES and the conflict situation

Majority of the farmers facing severe crop raiding were found to be confined within 1km from the fence. Studies elsewhere have shown that where agricultural farms abut protected areas 'frontline farmers' suffer more elephant depredation than those further away from the protected area boundary (Bell, 1984; Sukumar, 1990; Lahm, 1996; Naughton-Treves, 1997). The giving up of planting of certain crops by some farmers, habituation of elephant to traditional control measures as well as shifting by some farmers particularly in Dumbule from farming in their farms close to fence line to renting farming land elsewhere suggest that the conflict may be increasing. Naughton-Treves (1998) reported that farmers were constrained to leave their farming areas following increased severity of elephant crop raids in areas around Kibale National Park in Uganda. Increased conflict beyond the current level is bound to pit farmers against KWS if not checked as farmers may choose to disregard wildlife rules and regulations and start harming the elephants in self-defense.

In the whole process of mitigating the HEC in Mwaluganje, the sanctuary should not be seen to exist in isolation for it must relate to the surrounding area in terms of land-use. Evidence from field transect walks indicated that agricultural encroachment onto the fence line in some areas in Kibandaongo and Gandini was threatening the few remaining buffer zones, as farmers were clearing them into crop farms creating 'hard hedges[2]' between the farms and the fence. It is likely that with continued ecological changes particularly opening of the surrounding forest and bushes, which serve as buffer zone, elephant pressure is likely to increase. Studies elsewhere have shown that as wildlife range contracts as a result of natural habitat fragmentation induced by agriculture in the surrounding, the interfaces of potential human wildlife conflict have increased in such areas (Hoare, 1995; Osborn, 1998; Naughton-Treves, 1998; Hoare, 1999). The gradual creation of a buffer zone between the fence line and farming areas with use limited to grazing only as observed in Dumbule, although a daunting conservation cost to the farmers, is a possible land-use strategy in stemming down crop raiding incidences in the nearby farmlands in future. However, it will require the efforts of KWS in collaboration with MES management to develop an education and awareness programme to sensitize farmers on the other sites on importance of living uncleared areas as buffer zones between their farms and the fence. As an alternative, the farmers may be encouraged to start farm forestry in such established buffer zones. This

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[2] An open or cleared boundary between a conservation area and a crop field

would not only serve to cushion them against elephant crop raiding pressure but also bringing them economic benefits from timber. It is thus imperative that the KWS warden in charge of Shimba Hills Reserve gives full support to the MES management for a successful awareness programme about such joint initiatives aimed at mitigating the conflict in the area. The working of KWS and MES as a team in educating the people on proper farm planning and use around the sanctuary to reduce conflict with elephants will restore the seemingly lost trust and confidence in KWS by the community in handling the conflict in the area.

Implementation of seasonal and site-specific conflict alleviation measures

The survey showed the cost incurred to farmers by elephants include loss of food crops and disruption of their social activities such as free movement in the evening and children reporting to school late. This situation was worsened by the seemingly failing traditional coping strategies against the elephant menace. From farmers' responses, it was confirmed that traditional coping strategies against the elephant menace such as the use of fire, beating drums and stoning among others had become ineffective. On the other hand, while they had turned to KWS rangers patrol efforts to augment their weakening traditional coping strategies against the elephant menace, it appears the farmers are loosing the trust and confidence in KWS in handling the conflict with elephants. This is demonstrated by the 68.8 % of the farmers who agued that there would be no action from KWS on reporting elephant problems and those who said rangers always showed up late after the elephants had raided farms and left. Farmers' opinions on alternative conflict mitigation measure suggest their hope now lies in reducing the elephant population through translocation and the electric fence (Table 8). One option to boost the KWS rangers' efforts, which would go along way to ware down the lost trust in them by the community, would be for KWS to device seasonal and site-specific problem elephant control strategies.

Firstly, rangers patrol operations should be boosted during the peak season of crop raiding. The high incidences of crop raiding peaking when crops are maturing when natural stocks of elephant food is in high supply suggest that elephants have developed a taste for maize and cassava crops. In the forest range of Gabon, Lahm (1996) reported that crop raiding by elephants mostly occurred also during the wet season when crops were maturing. It seems sensible to suggest that boosting rangers' patrol efforts at this time would be most helpful in minimizing crop-raiding incidences. The rangers should maintain a close working relationship with the community to obtain maximum support in their patrol missions. One way to marshal maximum community support in such patrols would be to provide farmers with lights and radio systems especially during the peak crop raiding period (April- July and October- December) for proper coordination and fast response to spotted elephants during the patrols.

Secondly, the survey showed some areas particularly Kibandaongo and Gandini were reportedly far from the KWS station in Kwale for farmers to be able to report their elephant complains whenever they occurred. To fasten rangers' responsiveness to elephant problems in such distance places, KWS should consider establishing temporary outposts especially during the rain season when crop raiding is considered high. As the KWS rangers may not be enough to provide services everywhere and man those outposts whenever necessary, KWS in a joint venture with MES management should consider training and arming MES

scouts as rangers to augment KWS rangers' efforts in problem animal control in future. Such measures would not only provide help reduce the conflict but also provide more job opportunities to the local people and cause minimal social disruption than if people were to be moved to expand the sanctuary area to create more habitat for elephants. They would also solve the farmers' resentment and perceived KWS weakness of slow responsiveness to farmers complains which may be explained by the lack of enough rangers at the local KWS station.

The MES electric fence

Addressing fence design defects

The study shows that the MES electric fence was unsuccessful in deterring elephants from crop raiding as the survey showed (Table 9). The ineffectiveness may be particularly explained by poor fence construction design, which reduced its ability to function as psychological barriers against the elephants. Basically any electric fence is built to function as a psychological barrier against elephants by giving short sharp but safe electric shocks to the elephants thus serving to deter them from crossing the fence. Although the evening voltage readings were found to be high on average, elephants were found to break the fence almost daily despite daily maintenance by the fence team during the day. It appears that the fence did not generate enough shock to deter them from crossing over. The 0.3KV measured on the earthing pegs, which is on the higher side for the fence to give a strong shock (Baraza, Pers. comm.), clearly indicates a poor earthing system for the fence, which in turn weakens the strength of the electric shock. Although elephants have been reported to eventually find a way to break through most fences given time (Thouless, 1994; Nath and Sukumar, 1998), the absence of good earthing system in MES fence may have contributed much in the disrespect for the fence by the elephants given the weak electric shock generated by the fence. It is thus suggested that a proper earthing system be put in place for the fence. Research has shown that dry soils have little conductivity, which makes electric shock less effective (Thouless and Sakwa, 1995). Given that most parts where MES fence passes are dry and sandy, it would require that the management considers installing more earth pegs at a close range to counter the soil's poor conductivity effect. An earthing voltage measuring less than 0.1KV would be ideal to generate enough shock (Baraza, Pers. comm.) and hence deter elephants from crossing over.

Personal field observations indicated that poor construction of the fence across several ravines and the Manolo river (Fig.1) has also made the fence loose its meaning as elephants have established exit and entry routes in some of these points where the lowest fence strand was too high leaving wide unfenced gaps under the fence. Blocking these points to deter elephant exit may be done by providing the fence with suspended short lengths of electrified wire dangling from it at regular intervals along the main strand. This method, which has been observed to be successful in India (Nath and Sukumar, 1998), function to give electric shock to the fore head of crossing elephants and thus eliminating the possibility of the crossing at these points. In the unfenced Golini section, it is likely that elephants will keep on raiding farmers' fields even after the fence is rectified on the defects identified in this study so long as it remains open. To overcoming the problem, it is imperative that the fence is extended to cover the gap left. This would require, however, to be done carefully through negotiations with all MES stakeholders to change the negative attitude of the farmers opposed to the fencing idea.

While it is sensible to boost efforts to put in place an effective fence design, the success of such efforts may be hard to achieve given the high elephant population in Shimba Hills ecosystem. A study in Asia (Rice, 1990) reported that the ability of the habitat to provide adequate food for elephants might be a factor determining effectiveness of electric fence against elephants. It is thus likely that given the high elephant population in Shimba hills ecosystem, even the best designed fence may not be effective since elephants will break through in search of food. This is especially true given that degradation of their habitat is increasing as observed in some parts of the sanctuary during this study and others conducted earlier (Omondi et al, 1994; Mwathe, 1995; Kiiru, 1995; Litoroh, 2002). It is thus imperative that efforts to make the fence work effectively should go hand in hand with management of the elephant population as discussed earlier.

Results from the household survey and discussions with the fence maintenance team indicated that there exist habitual fence breakers in MES mainly bulls. The phenomenon of bull elephants taking more risk and learning how to disable fences has been similarly reported in Namibia (O'Connell et al., 2000). To handle this fence breaking behaviour under control, it may be necessary to shoot some of the habitual fence breaking individuals. It is usually believed that the killing of one or more elephants in a certain area deters others from visiting the same area (Ngure, 1995). However, this should be done carefully to ensure that only the real culprits are eliminated. Targeting only the habitual fence breakers will also result in considerably fewer elephants being shot in the long-term.

Policy and legislation changes and their implications on HEC mitigation

There is no clear policy on elephant conservation and management in Kenya. The government has no clear land-use policy and thus a multipurpose approach, which embraces designating and conserving protected areas buffer zones and traditional elephant migratory corridors from agricultural use, is lacking. This has led to serious human encroachment and fragmentation of elephant migratory corridors for agriculture with some getting completely cut off as has happened, for instance, with the elephant migratory corridor between Shimba Hills and Tsavo National Park, 60 km to the Northwest (Litoroh, Pers. Comm.). The ultimate result has been intensified human-elephant conflict. It is obviously expected that, with this policy gap, the few existing wildlife migratory corridors are bound to be transformed into agricultural land given the highly increasing human population in Kenya. To reverse the situation, the government should note that the long-term conservation of elephants will depend very much on an integrated approach on land use bordering protected areas, which takes into account not only their presence, but also their management. It is thus imperative for the government to consider passing conservation areas land use policy urgently to save the situation.

Under the Kenya's wildlife Act of 1975 (amended in 1989), the compensation policy is impartial on compensation of costs incurred on farmers by wildlife. People are only compensated when killed or injured by wildlife although this study showed farmers perceived it to be inadequate. Destruction of crops is not compensated. The lack of compensation for crop damages and a complicated procedure of getting compensation for

human loss or injury is perceived by the farmers as a neglect of the government of their losses. Such perceptions have been reported in other parts of the world (Kiss, 1990; Mishra, 1997). Unless the government addresses this problem by reviewing the policy to cover all forms of damages, farmers' attitude towards elephants will remain negative serving to frustrate the conservation efforts in the long-term. For efficiency and sustainability, implementation of such a policy should consider paying 'frontline farmers' adequately as they bear the most cost from elephant depredation as the study in MES revealed.

Besides helping to reduce HEC, culling may be an option to augment translocation, the most commonly used elephant population management tool used in Kenya. However, section 12 of the wildlife Act doesn't allow culling. Instead controlled shooting is practiced but as a conflict reduction measure (KWS, 1990). Even though from a moral and economic perspective it may not be appropriate to destroy large and economically valuable mammals such as elephants when the value of crop damage to the overall economy is relatively small (Tchamba, 1995), persistent adoption of such a policy can be a major hindrance for wildlife managers in managing wildlife populations shooting beyond their habitats carrying capacity. It can also be detrimental to the livelihood of poor farmers depending on subsistence farming as in the case of Mwaluganje. This is likely to increase the magnitude of a likely threat to the wildlife by farmers whose attitude is totally negative on failure of other existing conflict mitigation measures. It is thus strongly recommended that the policy be review to make it possible to manage elephant populations in fenced areas such as Shimba hills ecosystem where translocation exercises are faced with difficulties due to the rough terrain and associated high costs. Distribution of the meat coming from execution of culling programmes to farmers will also be creating additional incentives for them to tolerate some degree of conflict with elephants. Culling programmes, however, have been observed to cause disruption of elephant social structure and aggressive behaviour towards humans (Moss, 1988) and therefore they should be carefully done.

Conclusions

It is difficult to dispute that MES has tried to reduce the conflict that used to be prevalent in the area it occupies and its surrounding. This is exemplified by the positive attitude portrayed by MES members and dramatic decrease in human death and injury. These achievements would have been costly and difficult to make if the Kenya Wildlife Service worked on its on without engaging the community. For the future sustainability of MES in reducing the conflict, however, it should be recognized that the conflict has only been partially addressed and from the foregoing, it appears to be taking an upward turn. This study has unveiled several issues that need to be addressed to mitigate the conflict.

While members regard MES as their own and the presence of elephants to be benefiting them, however, non-members were found to have negative attitude towards MES and as a result were opposed to the MES conservation efforts. The prevalence of the crop damage by elephants and the lack of any benefits to the non-member, could only serve to undermine the conservation efforts of MES if not addressed. Adopting a more integrated approach that embraces combining community level small-scale projects well linked to conservation with individual compensation for crop losses may be a possible means of bringing benefits to non-members and improve their attitude.

Although all the ecotourism benefits went to the members, however, it appears that majority of the members were not satisfied with the amount they were getting from the enterprise. This if not checked might in time start affecting the members observed positive attitude and strong support for conservation in the area. The challenge for MES management remains to generate sufficient revenue to compensate its members given that they have decided to forfeit their land for elephant use. To get more tourists and hence generate more revenue for the members, MES management would need to give immediate attention to marketing its ecotourism enterprise aggressively besides exploring more avenues for income generation through diversification of its ecotourism products.

While it is important to focus on ensuring benefits accruing from MES flow to all members of the community neighbouring MES to win their support for conservation, it is vital that the problem with elephants be addressed as increased wildlife related benefits from MES might not necessarily translate to automatic support for the conservation efforts by the farmers in future. The results of the study on the elephant problem issue lead me to conclude that unless the high elephant population is controlled to much the area's carrying capacity, all other efforts to address the conflict will be in futility, as elephants will always move out in search of food. This is especially true given the fact that most parts of the habitat are now highly degraded as this study in addition to others done earlier have witnessed. Going for multiple countermeasures against the problem elephants and in managing the elephant population as discussed in the report earlier would be best suited in managing the human-conflict situation in Shimba hills. A set of the individual measures can act synergistically and make a difference. Training and harming MES scouts as rangers to augment KWS efforts in problem animal control would be added advantage in involving the community more in addressing the conflict with elephants affecting them.

Once the elephant population is controlled, making the MES electric fence work effectively will probably be the only long-term option in handling the conflict in the area unless other new methods are developed in future. However, given that elephants have known how to break the fence, its success will depend on commitments by the management to ensure good maintenance and the fence technicians to always ensure new fence designs are devised ahead of the elephants learning ability. Fencing the left part of the Golini should be urgently considered a priority as farmers crops in this area will always be the area of focus by elephants once the current fence is cleared of its current shortcomings.

Additionally, to reduce elephant crop-raiding pressure in farms close to MES fence, it is important that the sanctuary should not be seen to exist in isolation for it must relate to the surrounding area in terms of land-use. An education and awareness programme will be necessary to sensitize farmers bordering MES on the importance of maintaining buffer zones between their farmlands and the sanctuary. Last but not the least, if farmers and elephants are to co-exist peacefully not only in MES but also in others areas hosting local population of elephants in the country, it is vital that the current wildlife act be a reviewed to create a proper policy on land-use outside protected areas and on elephant population control.

Acknowledgement

References

Barnes, J.I., Macgregor, J. and Weaver L.C (2000) Economic Efficiency and Incentives for change within Namibia's Community Wildlife use Initiatives. *World Development*, Vol.30, No.4, 667-681

Barnes, R.F.W (1996) The conflict between humans and elephants in the Central African forests. *Mammal review* 26 (2) 67 - 80.

Bell, R.H (1984) The man-animal interface: An assessment of crop damage and Wildlife control. In *Conservation and wildlife management in Africa* (R. H Bell and E. Mcshare-Laluzi ed.) pp 39. US peace Crops.

Blackett 1994,H.L. (1994) Forest Inventory Report No.4. Shimba Hills, Mkongani North and Mkongani West. Kenya Indigenous Forest Conservation Project (KIFCON). Nairobi, Kenya.

Campbell, L.M (1999) Ecotourism in rural developing communities. *Annals of Tourism Research*, Vol. 26, No.3, 534-553

Central Bureau of statistics, 1999 population and Housing census. Population distribution by administrative areas and urban centers, Vol.1. Government printers, Nairobi.

Davies G., and Bennun, L. (1993) Biodiversity overview of Shimba Hills National Reserve, Mkongani Forest Reserve and Mwaluganje Forest Reserve. A report prepared by for the Kenya Indigenous Forest Conservation Project (KIFCON). Nairobi.

de Boer, F and Ntumi, C.P. (2001) Elephant crop damage and electric fence construction in the Maputo Elephant Reserve, Mozambique. *Pachyderm* 30: 57- 64

EAWLS (2000) Marketing strategic plan for Mwaluganje elephant sanctuary, Nairobi, Kenya.

FAO/UNESCO (1997) Soil map of the world 1:5000 000. Vol. 6, Africa. UNESCO, Paris. 299 pp.

Hoare, R (1995) Options for the control of elephants in conflict with people. *Pachyderm* 19: 54-63

Hoare, R.E (1999) Determinants of human-elephant conflict in a land-use mosaic. *Journal of applied ecology*, **36**, 689-700

Hoare, R.E. (2000) African elephants and human in conflict: the outlook for co-existence. *Oryx* 34 (1):34-38

Hoare, R.E. (2001) Management implications of new research on problem elephants. *Pachyderm* 28:73-78

Hough J.L. (1988) Obstacles to effective management of conflict between National

Parks and surrounding human communities in developing countries. *Environmental conservation* 15(2) 129-36.

Infield, M (1988) Attitudes of a rural community towards conservation and a local conservation area in Natal, S. Africa. *Biological conservation* **45**, 21-46

Kagwana, K (1995) Human-elephant conflict: the challenges ahead. *Pachyderm* 19:11-14

Kahumbu, P.G. (2000) The effects of elephants on their habitat in the Shimba Hills, Kenya. PhD Thesis, Princeton University.

Kamanga 1997, C.G (1997) Impact of increasing elephant densities on biodiversity in Shimba. A Consultancy report to the Kenya Wildlife Service, Nairobi.

Kenya Wildlife Service (1991) A policy Framework and Development Programme, 1991-1996.Kenya wildlife service. Nairobi, Kenya. 220pp

Kiiru, W. (1995a) The current status of human-elephant conflict in Kenya. *Pachyderm* 19: 11-14

Kiiru, W. (1995b) Human-elephant interaction around the Shimba Hills National Reserve, Kenya. MSc Thesis, University of Zimbabwe.

Kiss, A (1990) Introduction. In living with wildlife resource management with local participation in Africa (A. Kiss ed) 179pp. World Band, Washington DC, USA.

Kwale District Development plan, 2002-2008: effective management for sustainable Economic growth and poverty reduction. Government printers, Nairobi. 91 pp.

Lahm, S. (1996) A nation-wide survey of crop raiding by elephants and other species in Gabon. *Pachyderm* 21:69-77

Litoroh, M.W (2002) Aerial elephant count in the Shimba Hills ecosystem, Kenya. *Pachyderm* 32: 55-63

Litoroh, M.W., Njue, A., Bitok, E. and Omondi, P. (2001) Elephant-habitat interaction study in Shimba Hills National Reserve. Final Report to WWF/KWS on analysis of data collected between 1996 and 1999 under WWF/KWS Project Ref: KE0097.72, Nairobi.

Mwaluganje Elephant Sanctuary (MES) (1994) Memorandum of Association of Mwaluganje community wildlife Reserve Ltd. Kwale, Kenya.

Mishra, C. (1997) Livestock depredation by large carnivores in the Indian trans-Himalayan: conflict perception and conservation prospects. *Environmental conservation* 24:338-343

Moss, C (1988) Elephant memories: Thirteen years in the life of an elephant family. William Morrow and Co., Inc. New York. 336 pp.

Muir, E.C. (2000) Monitoring the impact of Mwaluganje elephant translocation to Tsavo East National Park. Unpublished report to the Kenya Wildlife Service, Nairobi. 31pp

Mwathe, K.M (1995) Elephant-habitat interaction study in Shimba Hills National Reserve: elephant density estimates (floristic composition and elephant habitat damage assessment). Annual report to the Kenya Wildlife Service, Nairobi.

Nath, C.D and Sukumar, R. (1998) Elephant-human conflict in Kodagu, South India: distribution patterns, people's perceptions and mitigation methods. Asian Conservation Centre, Bangalore, India. 72 pp.

Naughton T. L, Rose, R. and Treves A (1999) The social dimensions of Human elephant conflict in Africa: A literature review and case studies report from Uganda and Cameroon presented to IUCN Human elephant conflict Task force, Glands, Switzerland.

Naughton-Treves, L (1997) Farming the Forest edge: vulnerable places and people around Kibale National Park, Uganda. The Geographical Review 87 (1): 27-46

Naughton-Treves, L (1998) Predicting patterns of crop damage by wildlife around Kibale

National Park, Uganda. *Conservation Biology*, 12 (1), 156-158

Naughton-Treves, L (2001) Farmers, Wildlife, and the Forest Fridge. Yale University, UK.

Nchanji, A.C., and Lawson, D (1998) A survey of elephant crop damage around the Banyang-Mbo wildlife sanctuary, 1993-1996. Cameroon Biodiversity Project and wildlife. Yaounde, Cameroon.

Ngure, N (1995) People-elephant conflict management in Tsavo, Kenya. *Pachyderm* 19: 20-25

Omondi, P., Mwathe, K and Reuling, M. (1994) Effects of increasing confinement on elephant/habitat interaction in Mt. Kenya and the Shimba Hills Forests Reserves. Kenya Wildlife Service Elephant Programme annual report. Nairobi, Kenya.

O'Connell, C.E., Rodwell, T., Rice, M and Hart, L.A (2000) Living with the modern conservation paradigm: can agricultural communities co-exist with elephants? A five-year case study in East Caprivi, Namibia. Biological conservation 93:381-391

Osborn 1998, F.V (1998) The ecology of crop raiding elephants in Zimbabwe. PhD Thesis, University of Cambridge.

Osborn, F.V., Parker, G.E (2002) Community-based methods to reduce crop loss to elephants: experiments in the communal lands of Zimbabwe. *Pachyderm* 33:32-38

Reuling, M., Mwathe, K., Litoroh, M and Poole, J. (1992) A survey of Shimba Hills elephant population. Kenya Wildlife Service, Nairobi.

Rice, C. (1990) Don't forget the trunk. *Wildlife conservation*, 93:58-67

Jatzold, R. & Schmidt ,H (1983). Farm handbook of Kenya. Vol. II/C. East Kenya. Ministry of Agriculture, Kenya, in Cooperation with German Agricultural Team (GAT) of German Agency for Technical Cooperation (GTZ). Erhart GmbH, Trier.

Schmidt, R. (1991) Ecology of Tropical lowland rain forest: plant communities, soil characteristics and nutrient relations of forest in Shimba Hills National Reserve of Kenya. Dissertation Botanicae 179, J. Cramer Berlin, Stuttgart, 211 pp.

Sibanda, B. (2001) Wildlife and communities at the crossroads: is Zimbabwe's CAMPFIRE the way forward? SAPES Trust, Harare, Zimbabwe. 281pp

Songorwa, N (1998) Community-based wildlife management in Tanzania: Are communities interested? World Development 27:2061-2079

Sukumar, R. (1990) Ecology of the Asian elephant in southern India II: feeding habits and crop raiding patterns. *Journal of Tropical Ecology* 6:33-53.

Taylor, R.D (1993) Elephant management in Nyaminyami District, Zimbabwe: turning a liability into an asset. *Pachyderm* 17: 19-29

Tchamba, M (1996) History and present status of the Human/elephant conflict in the Waza-Logone region, Cameroon, West Africa. *Biological Conservation* 75:35.41.

Thouless, C. R (1994) Conflict between humans and elephants on private land in Northern Kenya. *Oryx* 28:119 - 127

Thouless, C.R., and Sakwa (1995) Socking Elephants: Fences and crop raiders in Laikipia District, Kenya. *Biological conservation* 72: 99 - 107.

Verlag, W (1995) Ecotourism as a conservation instrument? Making conservation projects more attractive. Research reports of the Federal Ministry for Economic Cooperation and Development, BMZ, German. Vol. 117, 327pp

Warinda, E. (2001) Economic analysis of land use option in Mwaluganje elephant sanctuary. Unpublished report to the East African Wildlife Service, Nairobi. 25pp

Appendix I: Survey questionnaire

ASSESSING THE INFLUENCE OF THE MWALUGANJE ELEPHANT SANCTUARY ON THE LOCAL COMMUNITY IN THE NORTH SHIMBA HILLS CONSERVATION ECOSYSTEM, KENYA.

Questionnaire No………………
Interviewer……………………

A. Background information (Tick where appropriate)

1. Sex: Male   Female

2. How old are you? _____ years

3. Name of your sub-location: _____

4. Tribe: _____

5. Level of education: No schooling   ; Primary education   ; Secondary   ; University

6. Duration of stay in your village: Less that 1 year   ; 1-5 years   ; 6-10 years
   more than 10 years   ; Born here   ; Don't know

7. Are you a member of the Mwaluganje Sanctuary: Yes   No
   If yes, for how long have you been a member?   _____years

   If not, tell us why
   _____

   _____

B. Source of income (economic Activity)

8. Source of living for the household: Crop farming   ; Cattle keeping   ; Mixed farmer
Fishing   ; Charcoal selling   Others   _____

9. Are you employed? Yes   No   If yes, what kind of a job   _____

10. Length of residence by economic activity
    a) Crop farming: 1-5 years   ; 6-10 years   11-20 years   ; More than 20 years
    b) Cattle keeping: 1-5 years   ; 6-10 years   11-20 years   ; More than 20 years
    c) Mixed farmer: 1-5 years   ; 6-10 years   11-20 years   ; More than 20 years
    d) Charcoal selling: 1-5 years   ; 6-10 years   11-20 years   ; More than 20 years

e) Others: 1-5 years   ; 6-10 years   11-20 years   ; More than 20 years

11. How large is your crop farm/shamba (in acres) < 1 acre   ;   1– 2 acres   ;
    3 – 4 acres   ;   > 4 acres
   Indicate the form of landownership: Personal property with a title deed   ; Personal but
   no title deed   ; Rented farm

12. How far is your farmland from Mwaluganje Sanctuary boundary?
    <1 KM   ;   1 – 2 KM   ;   2-3 KM   ; $\geq$ 3 KM

13. What Kind of crops do you grow in your farm?
    Food crops: Maize   ; beans   ; Coconut   ; Vegetables   ; Fruit trees   ; Cassava ;
    f) others _____

    _____

    Cash crops: a) Bixa b) others   _____

14. Which domestic animals do you keep if any? Cattle   ; Goat   ; Sheep   ; Pigs   ;
    Poultry   (f) Others _____

C. Attitude towards Mwaluganje Sanctuary

15. Has Mwaluganje Elephant Sanctuary benefited people living around it?
    Yes   ;   No   I don't know

16. Has this household in any way participated in the activities of the sanctuary
    establishment? (e.g. roads and gates construction)? Yes   ;   No

    If yes, in what way? Were/are you paid for the work or you did it voluntarily?
    _____
    _____

17. Below is a list of 5 advantages of living around the MES. Please rank them in order of
     importance by giving a score value from the most important to the least important
    (i.e. 1,2,3,4,…)
    a)   Community development projects by MES e.g. schools, roads construction etc   ——
    b)   Employment_____
    c)   Problem animal control _____
    d)   Tourism revenue sharing as a member of MES   _____
    e)   Environmental benefits ——

18. Below are 4 disadvantages of living near Mwaluganje Elephant Sanctuary. Please
    rank in order of importance by giving a score value from the most to the least important
    (i.e. 1,2,3,4…..)

    a)   Elephant crop damage _____
    b)   Elephant attacking people ——

c) Loss of access to MES area resources e.g. fuel wood, building materials, fish, etc ——
d) Problem with MES management _____

19. By ticking where necessary, please tell us whether or not the actions of MES have resulted in the improvement of the following items in your community

a) Roads network improvement :   Very much   ; Much   ; Somewhat   ; No

b) School facilities   :   Very much   ; Much   ; Somewhat   ; No
c) Water Facilities   :   Very much   ; Much   ; Somewhat   ; No

20. As a member of MES, how do you use the benefits/income from the sanctuary? List the various uses
i) _____
_____
ii) _____
_____

21. If you are a MES member, how many shares do you own?   _____

22. If you are a MES member of, please tell us to what extent you think MES ecotourism has been of benefit to you by ticking one of the ranks given below

Very much   ;   Much ;   Somewhat ;   No

a)   Comment on any problems concerning the benefits you get from MES tourism

_____
_____
_____

b) Any other problems facing MES tourism enterprise and need to be addressed (list in order of importance)
(i) _____
ii) _____
iii) _____

c) What are your suggestions/ideas to overcome the above stated problems on MES tourism (suggestions for enterprise improvement)?
(i) _____
ii) _____

D. Current Elephant and other wildlife related problems
23. Following the establishment of the sanctuary fence, is crop damage by elephants still a problem? Yes   ; No
24. What season of the year are elephants most disturbing in this area?

25. Has there been a change in the amount of your farm produce in the last 5 years?
Increased ;   Decreased ;   No change in crop harvest amounts

If amount has decreased, give **the main reasons** why ——————————————

If No change, give reasons why _____

_____
_____

26. If crop damage by elephants still occurs, how often do you experience it personally?
    a) very often –at least once a week
    b) Often – once or twice in a month
    c) Rarely – less than 5 times in a year
    d) It don't experience it

27. What crops do you grow that are commonly eaten by elephants? List in order of preference by the elephants

    _____
    _____

28. What crops do you grow that are not eaten by elephants?
    _____
    _____

29. Are there any crops that you've stopped planting due to elephant problem?
    Yes   ; No
    If yes, List in order of importance   _____
    _____

30. Do you report incidences of crop damage to Kenya Wildlife Service
    (KWS) every time it occurs? Yes   ; No
    If No, explain why _____
    _____

31. How often do you see Kenya Wildlife Service (KWS) holding barazas in this area to discuss wildlife issues?
    Very often ;   Often ;   Rarely ;   I don't see KWS

32. What other problems apart from crop damage are associated with elephants in this area?
    i) _____
    ii) _____
    iii) _____

33. What other wild animals raid your farms apart from elephants (List)
    i)
    ii)
    iii)

34. How severe is crop damage by elephants today compared with other animals from the Sanctuary? a) Less severe   b) More severe

35. Has the sanctuary fence helped keep away elephants? Yes   ; No

36. What do you think might be reducing the fence effectiveness in controlling elephants?
    i) Lack of fence maintenance (repair/Clearing)
    ii) Damage by people
    iii) Elephant trampling
    iv) Damage by livestock
    iv) Others _____
    _____

37. What do you consider to be **other causes of elephant problems** in this area?
i) _____
ii)_____
iii) ——————————————————————————

38. What **traditional methods** do you use to control elephant damage to your crops?
    i)
    ii)
    iii)
Others _____

39. What other management measures apart from the fence do you suggest need to be applied to ensure effective control of elephant damage to crops?

    i) _____
    ii)_____
    iii) ——————————————————————————

40. If problem elephant management in the area needs to be improved further, in what way are you willing to contribute?
    i) _____
    ii)_____
    iii) ——————————————————————————

41. What is your general view about the future of the sanctuary versus the community livelihood?

    _____
    _____

42. Any other issues about MES that need to be addressed?

    _____

    _____

Appendix II: Fence Survey form

MES fence damage documentation for the month of: ＿＿＿＿＿＿＿＿
Gate: ＿＿＿＿＿＿＿

Date	End 1 A.M	End 1 P.M	Mid-line Voltage	End 2 A.M	End 2 P.M	No. posts damaged	No posts challenged	No. wires cut	No. wires striped from post	No. insulators damaged	Signature
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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30											
31											

Appendix III. Demographic details of respondents from the four survey sub-locations bordering MES.

Sub-location	Sex		Tribe				Economic activity		Membership in MES		Employment	
	No. of Male	No. of Female	Digo	Duruma	Giriama	Other	Crop farming	Mixed farming	Member	Nonmember	Yes	No
Dumbule	31	13	17	24	2	0	16	27	22	22	4	84
Gandini	27	17	8	27	8	1	24	20	22	22	7	81
Kibandahongo	29	15	3	34	2	0	14	30	22	22	4	84
Golini	27	17	40	3	9	2	21	24	22	22	4	84