

Reducing Illegal Bushmeat Hunting in Tanzania: An Opportunity for The Open University of Tanzania: A Review

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Abstract: *Illegal exploitation of wildlife for bushmeat – non-domesticated terrestrial mammals, birds, reptiles and amphibians harvested for food and income – is a matter of increasing concern for Africa’s wildlife areas. In Tanzania, the problem is intensifying, and research has already established that wildlife populations across different ecosystems are contracting. A major challenge lies in ensuring sustainability of the remaining wildlife amid pressures from local communities who are constantly trying to work their way out of poverty. In this regard, open and distance learning (ODL) system has an important role to play in promoting conservation through imparting ecological knowledge to a broader community. The present paper highlights options through which The Open University of Tanzania, as an ODL institution, can significantly contribute to controlling bushmeat exploitation from the following perspectives: agricultural development, metapopulations, ecological monitoring, community-based conservation, protein alternatives to bushmeat and conservation enforcement.*

Key words: Bushmeat exploitation, wildlife, conservation, Open University of Tanzania

INTRODUCTION

Roth and Merz (1997) describe two types of consumptive utilisation of wildlife as utilisation for commercial purposes (mainly through tourist hunting) and subsistence hunting. The latter can either be legal- where local communities are allowed to hunt by laws regulating the use of wildlife or illegal- where wildlife is utilised regardless of whether or not the wildlife laws permit it. Subsistence hunting is often unsustainable, and mainly done to harvest bushmeat (Taylor and Dunstone, 1996). Bushmeat can be defined as “any non-domesticated terrestrial mammals, birds, reptiles and amphibians harvested for food” (Nasi *et al.*, 2008). Some other definitions pay special attention to Africa, where bushmeat hunting is believed to be problematic. For example, bushmeat has also been defined as “an African term that includes all wildlife species used for food, from cane rats to elephants” (Bennett *et al.*, 2006). In Africa, bushmeat hunting is valued not only as a source of protein, but also as a means of income generation (Brashares *et al.*, 2004; Bennett *et al.*, 2006). It has, therefore, become a veritable minefield of conservation and ecological concerns (Baldus, 2002; Fusari and Carpaneto, 2006; Lindsey *et al.*, 2011).

Escalating demand for bushmeat affects individual animal species, populations, communities and ecosystems (Davies and Brown, 2007; Nasi *et al.*, 2008; Hayward, 2009; Wilfred, 2010; Lindsey *et al.*, 2011). For example, illegal bushmeat hunting can cause wildlife population decline to irrecoverable levels (Milner-Gulland and Akçakaya, 2001; Brashares *et al.*, 2004) and promote female-biased sex ratios among species (Setsaas *et al.*, 2007; Marealle *et al.*, 2010), consequently affecting both birth and population growth rates in the majority of the mammal species (Ndibalema, 2009). It is increasingly apparent that controlling bushmeat hunting must be the main theme of the current debate over sustainable wildlife conservation (see Hofer *et al.*, 1996; Fa *et al.*, 2005; Rist *et al.*, 2008; Willcox and Nambu, 2007; Mfunda and Røskaft, 2010). Unfortunately, the potential of distance education in curbing the problem is often less explored.

The importance of education as a tool for conservation cannot be overstated, in Uganda for instance, Olupot *et al.* (2009) note that education is a vital ingredient in promoting conservation awareness. Elsewhere, education is said to unleash creativity for initiating different sustainable income generating activities in areas of conservation importance (Wilfred, 2010). For example, the College of African Wildlife Management (CAWM) in the Kilimanjaro region of northern Tanzania has been offering educational training for different government officials responsible for wildlife conservation across the country in quest for building their capacity. A lot of other institutes in the country also offer wildlife conservation courses at different levels, but there is need to ensure that wildlife conservation knowledge reaches a wider community. Caro and Scholte (2007) consider “outreach programs” to be an important vehicle for enhancing conservation awareness and controlling unsustainable use of wildlife. Outreach programs work hand in glove with extension services. Since extension services in Africa are generally confronted by a number of challenges including fewer and inexperienced extension officers, financial constraints, and lack of incentives to do extension work (Gebremedhin *et al.*, 2006), distance education remains a potentially crucial contributor to halting unsustainable wildlife offtakes. This paper uses The Open University of Tanzania (OUT) to recount in microcosm the potential of the open and distance learning system (ODL) in Tanzania in raising the public awareness towards reducing illegal bushmeat hunting.

As an ODL institution, OUT has the potential to effectively reach a wider community, and build capacity for conservation. The University is reputable, flexible and it offers quality education. It has over 25 regional learning centres distributed all over the country. Of the University’s faculties, the Faculty of Science, Technology, and Environmental Studies (FSTES) is the most relevant platform for conservation courses. The faculty has been offering a course titled “principles of ecology”, which contains some elements of conservation science, but there is still work to do to broaden the scope of the conservation knowledge offered by encompassing contemporary conservation needs in all qualifications namely: Bachelor, Master and PhD. To show the need and scale of the work, this manuscript presents the nature and scope of the bushmeat problem in the country and suggests solutions while exploring how the University can contribute towards mitigating the problem.

CONSERVATION AREAS IN TANZANIA

Tanzania is among the African countries rich in protected areas (Severre, 2003). Twenty eight percent of about 900,000 sq. km. of land area of the Tanzanian mainland is occupied by protected areas set aside for wildlife conservation. The network of protected areas includes the Ngorongoro Conservation Area (1% of the total area under protection), 15 national parks (4%), 33 game reserves (15%) and 43 partially protected areas (10%) (Leader-Williams, 2000; Shivji, 2001, see also Figure 1). The national parks are the areas rich in biodiversity and contain high quality wildlife habitats. They are aimed at preserving Tanzania's rich natural heritage and conserving representative habitats and wildlife resources. Consumptive use is strictly prohibited; the only activities permitted are non consumptive tourism, education and research. Wildlife conservation in the national parks is administered by the Tanzania National Parks Authority (TANAPA). Game reserves on the other hand, constitute the largest proportion of the land under conservation. The main activity in the game reserves is trophy hunting although non-consumptive tourism, research and education are also encouraged. Their management is administered by the Wildlife Division of Tanzania. Ngorongoro Conservation Area, which borders Serengeti national park to the north and west, is a United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site.

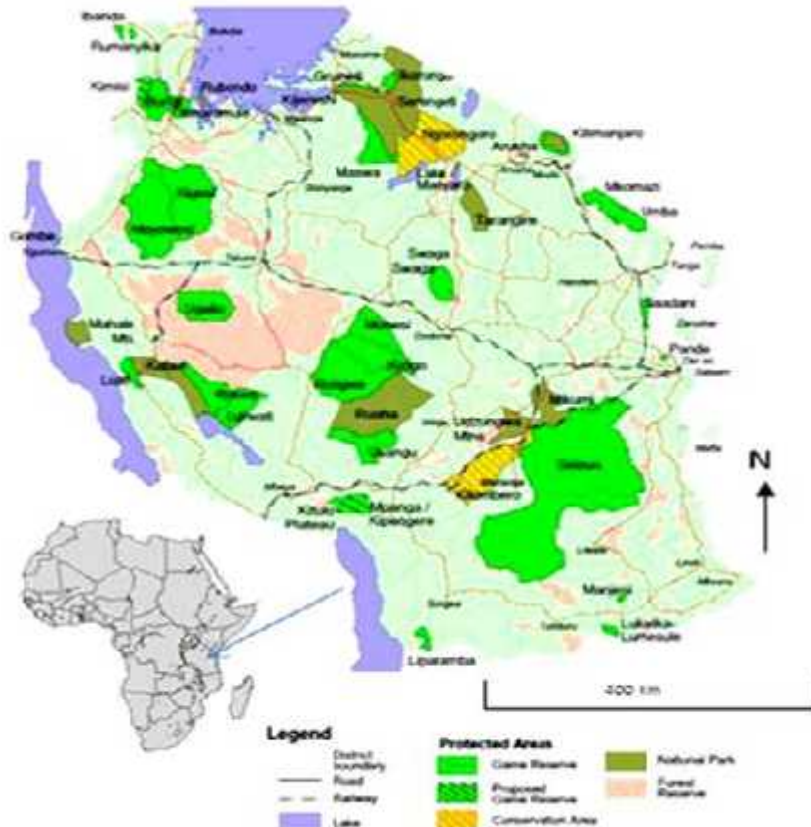


Figure 1: Map of Tanzania Showing the Distribution of Protected Areas. An Inset Map of Africa Shows the Location of Tanzania. Adapted from URT (2006)

It was established as a pilot project for integrated land use, encompassing activities such as pastoralism, wildlife conservation, photographic tourism, research and education. Ngorongoro is managed by the Ngorongoro Conservation Area Authority. The partially protected areas provide a buffer zone for core protected areas. They contain more land use activities than any other category of protected areas (Shivji, 2001). Apart from having all types of land-uses present in other protected areas, legal subsistence hunting, fishing, beekeeping as well as restricted human settlements may also be permissible in the partially protected areas.

BUSHMEAT HOTSPOTS AND OUT

Table 1 summarises information from 26 papers that dealt with bushmeat issues in different ecosystems lengthily. The majority of the studies were carried out in the Serengeti ecosystem (52%). About 60% of OUT regional centres are neighbouring the bushmeat prone ecosystems. With the exception of Ruaha landscape and Ugalla ecosystems, all the ecosystems were adjacent to at least two regional centres. A variety of different factors and solutions behind the bushmeat problem were put forward, apparently mostly location-specific (Table 1), which is absolutely acceptable as solutions to tackle conservation problems in one area might not necessarily be valid in another. Essentially, the recommended solutions are related to agricultural development, ecological monitoring and conservation, institutional arrangement, availability of alternatives to bushmeat, community based wildlife management, local livelihoods improvement and wildlife law enforcement. These factors offer priority areas for dealing with the problem. To comprehend them, and more importantly to identify entry points for dealing with bushmeat issues, here below are an expansion on the factors and some light on similar scenarios elsewhere.

Table 1: Selected bushmeat studies showing suggested measures to tackle the bushmeat crisis across different regions in Tanzania. The OUT regional centres in bushmeat-prone regions are also shown. Studies are arranged chronologically

Author & year of publication	Ecosystem research was conducted	The nearest OUT regional centre(s)	Proposed solution to bushmeat hunting
Hoffer <i>et al.</i> (1996)	Serengeti	Mara, Arusha, Shinyanga	Effective law enforcement, Awareness creation, Community conservation services, Viable alternatives to bushmeat
Gillingham and Lee (1999)	Selous Game Reserve	Coast, Morogoro, Ruvuma, Mtwara, Lindi	Institutional arrangements to allow fair distribution of conservation benefits and adequate integration of local communities in wildlife management issues
Campbell and Loibooki (2000)	Serengeti	Mara, Arusha, Shinyanga	Rural livelihoods improvement
Carpaneto and Fusari (2000)	Ugalla	Tabora	Effective wildlife management, Human population monitoring,

			Further researches on wildlife conservation
Campbell <i>et al.</i> (2001)	Serengeti	Mara, Arusha, Shinyanga	Effective poverty alleviation strategies, Diversified sources of cash income
Baldus (2002)	Selous Game Reserve	Coast, Morogoro, Ruvuma, Mtwara, Lindi	“Wildlife management areas” is a vital tool for protecting and conserving wildlife resources
Holmern <i>et al.</i> (2002)	Serengeti	Mara, Arusha, Shinyanga	Do away with game cropping activities and encourage other income generating ventures
Loibooki <i>et al.</i> (2002)	Serengeti	Mara, Arusha, Shinyanga	Agricultural development especially “improving small livestock such as goats and sheep”, Effective poverty alleviation strategies
Baldus <i>et al.</i> (2003)	Selous Game Reserve	Coast, Morogoro, Ruvuma, Mtwara, Lindi	Community based wildlife management
Holmern <i>et al.</i> (2004)	Serengeti	Mara, Arusha, Shinyanga	Improved agricultural production, Improved local agricultural based income generating activities
Johannesen (2005)	Serengeti	Mara, Arusha, Shinyanga	Enhanced cotton and maize production, Reduced crop and livestock loss to wildlife
Kaltenborn <i>et al.</i> (2005)	Serengeti	Mara, Arusha, Shinyanga	Sustainable wildlife based rural development
Nielsen (2006)	Udzungwa Mountains	Iringa, Morogoro	Improved livestock production for low income families, increased economic openings especially in villages adjacent to forest reserves, Monitored human populations near forest reserves
Holmern <i>et al.</i> (2007)	Serengeti	Mara, Arusha, Shinyanga	Strengthening wildlife law enforcement, especially through empowering village game scouts
Jambiya <i>et al.</i> (2007)	Refugee camps	Kagera, Kigoma	Considerations of bushmeat trade legalisation, Sustainable legal provision of livestock meat and bushmeat, Viable sources of income
Ndibalema & Songorwa (2007)	Serengeti	Mara, Arusha, Shinyanga	Effective conservation of all species with extra attention paid to most preferred ones
Caro (2008)	Katavi-Rukwa	Katavi, Rukwa	Sustainable and multiple approaches for assessing and controlling wildlife decline

Baldus & Hahn, (2009)	The Selous – Niassa Wildlife Corridor	Mbeya, Ruvuma	Effective community based natural resources management
Knueppel <i>et al.</i> (2009)	Ruaha Landscape	Iringa	Promoting income generating activities
Magige <i>et al.</i> (2009)	Serengeti	Mara, Arusha, Shinyanga	Awareness creation and Agricultural development
Nyahongo <i>et al.</i> (2009)	Serengeti	Mara, Arusha, Shinyanga	Promoting income generating activities, and Encouraging sustainable local supply of fish
Topp-Jørgensen <i>et al.</i> (2009)	Udzungwa Mountains	Iringa, Morogoro	The study emphasizes the importance of assessing the efficiency of the joint forest management in the bushmeat-prone areas
Mfunda & Røskoft (2010)	Serengeti	Mara, Arusha, Shinyanga	Effective community based conservation, Agricultural development, Effective law enforcement, Livelihood improvement through viable and sustainable conservation benefits
Wilfred & MacColl (2010)	Ugalla	Tabora	Rural livelihoods improvement
Brashares <i>et al.</i> (2011)	West/Central Tanzania	Morogoro, Iringa, Dodoma, Tabora & Shinyanga	Promoting alternative sources of livelihood
Nielsen (2011)	Udzungwa Mountains	Iringa, Morogoro	Effective institutional arrangements and benefit sharing schemes

Agricultural Development

It has been widely acknowledged that agricultural activities are closely related to wildlife exploitation. For example, in Serengeti there has been a close relationship between agricultural production and wildlife poaching (Barret and Arcese, 1998). Johannesen (2005) found that an increase in the sizes of some food and commercial crop farms lessened illegal hunting in Serengeti, but warned that livestock predation and crop raiding by wild animals could perpetuate poaching in the area. A bushmeat study in the Congo Basin also acknowledged the role of agriculture in halting wildlife exploitation intensity (Fa *et al.*, 2003). Agriculture has the potential for ensuring food security, and thereby reducing bushmeat exploitation (de Klerk *et al.*, 2004). Local subsistence farming is said to minimise farmer dependency on wildlife in Nepal by significantly improving livelihoods (Shrestha and Alavalapati, 2006). Crops and livestock sales provide substantial income at a household level (Wilfred and MacColl, 2010). On the other hand, agriculture alters wildlife habitats (Laurance, 2008). Farm encroachments in the areas around Kilombero Game Controlled Area in Tanzania are a good example (Haule *et al.*, 2002). Unsustainable agriculture is one of the land use activities jeopardizing the health of the wildlife

habitat in Europe (Stavriniadis and Anayiotos, 2006). Mechanised agriculture coupled with high usage of chemical fertilizers has been responsible for wildlife habitat degradation in both Africa (Kideghesho *et al.*, 2006) and Europe (Young *et al.*, 2005).

Adoption of low-input agriculture characterised by good management of chemical fertilizers (Weinberg, 1990; Mkpado and Onuoha, 2008), building the capacity of farmers, and firm integration of indigenous knowledge (Mkpado and Onuoha, 2008) would be the best way forward for improving agricultural yield, conserving habitats and reducing bushmeat problems in the areas of conservation importance. This is practically part of eco-agriculture. Eco-agriculture is defined as “a fully integrated approach to agriculture, conservation and rural livelihoods, within a landscape or ecosystem context” (Scherr and McNeely, 2008). Promoting eco-agriculture, especially in Africa, is a function of agricultural extension and education (McNeely and Scherr, 2001). Cook (1998) and Demiryürek (2010) argue that distance education is a useful tool for agricultural education extension. Without doubt, OUT through FSTES can offer such knowledge. OBL 204 (soil science) is but one example of its contribution to agricultural knowledge. Expanding our scope to include courses related to increasing agricultural production in an environmentally friendly way would improve local livelihoods and reduce the demand for bushmeat.

Ecological Monitoring as a Conservation Tool

Since human land uses and population growth in wildlife areas occur concomitantly with landscape alterations (Mundia and Murayama, 2009), wild animals are rapidly losing their habitats as a result of fragmentation, and deterioration of habitat quality and quantity (James, 2006). This has created habitat patches of different carrying capacities (James, 2006; Caro and Sherman, 2011), thus increasing the vulnerability of wildlife to illegal hunting (poaching) pressure (Redford, 1992; Kinnaird *et al.*, 2003). Ecological monitoring, as a means of understanding wildlife exploitation pressures, has therefore become vital to modern conservation (Kahindi, 2009). Monitoring in this case encompasses a range of activities or tasks to understand how, why and to what degree animal abundances, distributions and population trends are influenced by habitat modifications and human actions (Milner-Gulland and Rowcliffe, 2007). Ecology, on the other hand, is “the scientific study of the factors and interactions that determine distribution and abundance” (Begon, 2006; Gilbert, 2012).

Ecology courses at OUT [for example: Principles of Ecology (OZL 351), Ecology (OEV 101) and Principles of Ecology and Ecosystem Management (OEV 603)] are an ideal place for providing ecologists and conservationists in this country with the necessary ecological monitoring knowledge, skills, and abilities to make a significant contribution to halting wildlife loss. Although there is no cap, it is believed that addressing and/or improving the following ecological elements would guarantee this.

Metapopulations

Owing to environmental challenges, as described above, populations of different wildlife species occur in habitat patches of various shape, size and quality. That

means “the population of a species may consist of a group of spatially discrete subpopulations” (Smith and Smith, 2009). In 1969, a population ecologist Richard Levins coined the term **metapopulation** to describe this scenario. In fact, it is a network of local populations, each unable to maintain itself without immigration from other patches (Begon *et al.*, 2006; Smith and Smith, 2009). The patches can be classified into ‘sources’ (when they donate individuals to other patches) and ‘sinks’ (receiver patches) (Begon *et al.*, 2006). In source patches, births exceed deaths (i.e. the intrinsic rate of natural increase $r > 0$), the opposite is true in sink patches (see Figure 2)

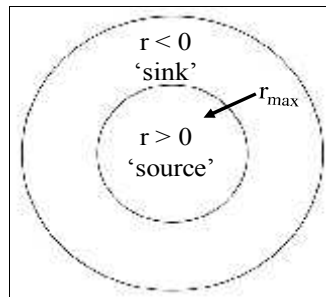


Figure 2: Hypothetical Source-Sink Dynamics

Any two wildlife sites with different exploitation intensities or protection status can constitute a source-sink system (Bennett, 1999) where animals move to and fro between the source (non-hunted or slightly hunted areas) and the sink (commonly hunted areas) (Novaro *et al.*, 2005; Naranjo and Bodmer, 2007). What happens to a species in the sink, as a result of exploitation, can be the best indicator of the status of the same species in the source. For example, species off-take trend in the hunted areas adjacent to non-hunted or slightly hunted areas can act as a proxy indicator of its population performance in the latter. On balance, this knowledge can be effectively used in population monitoring situations.

Rarity, Extinction and Viability Analyses

Most wildlife species are naturally rare as a result of a number of species-specific traits, namely, self compatible or asexual breeding, low reproductive rate, poor dispersal ability, homogeneous genetic structure, poor competitive ability, specialist (in resource use), their habitat is rare or lost, higher trophic level species in the food chain, susceptible to diseases, larger size, easily affected by environmental devastations and invader/new species not adapted to the area (Gilbert, 2012). Species possessing most of these traits are likely to become extinct especially in the presence of natural and/or human destructive activities such as habitat loss and overexploitation (Begon *et al.*, 2006). Nonetheless, extinction does not take place in a vacuum, there are factors that predispose species to extinction namely: long gestation period, bigger home range, low population density, restricted geographical range and human population pressure. The ecological monitoring for conservation must encompass and integrate these factors.

The conservation literature has highlighted a number of models to assess status and extinction probabilities of wildlife species. For example, population viability

analysis (PVA) which estimates factors influencing population vulnerability and extinction using computer-based packages such as Vortex and RAMAS (Milner-Gulland and Rowcliffe, 2007). Density estimation using distance sampling software is a suitable approach for estimating the population status (Buckland *et al.*, 1993). Such models are fundamental to contemporary ecology and conservation biology.

Other Related Issues

These include invasive species and management strategies – “invasion occurs when a species colonizes and persists in an area which it previously had not inhabited” (Shigesada and Kawasaki, 1997). Island biology – this involves the study of the factors that influence species richness of isolated or discrete wildlife communities (Begon *et al.*, 2006). The International Union for Conservation of Nature (and Natural Resources) (IUCN) Global Red List Criteria and Process – IUCN have been publishing red data books and red lists for species of conservation concern for many decades. These provide global index of the biodiversity status and a tool for natural resources conservation monitoring.

Conservation Enforcement

There has been a strong desire to effectively protect wildlife resources with an increased emphasis on enforcing wildlife laws through anti-poaching patrols (conservation enforcement), where trained patrollers deter poaching or apprehend poachers and take them to justice. To date, we are aware of the need for effective anti-poaching patrols across different wildlife areas in Africa. The idea of law enforcement bears close relationship with the American Yellowstone model also known as “fortress conservation” or “fences and fines” conservation approach (Norgrove and Hulme, 2006) that despises natural resources related needs and interests of people, particularly those near conservation areas (Pimbert and Pretty, 1995). While some conservationists defend fortress conservation and the top-down approach to wildlife law enforcement (for example, Fischer, 2008), the other school of thought emphasises a more participatory law enforcement where local communities are actively involved in the protection of buffer zones, wildlife corridors, game controlled areas, open areas and other lower category protected areas (Mesterton-Gibbons and Milner-Gulland, 1998; Baldus *et al.*, 2003; Kafle and Balla, 2005). Since resources (financial resources, trained personnel etc.) for law enforcement are always scarce (Hilborn *et al.*, 2006), monitoring and community based conservation are the preferred supplements to traditional anti-poaching measures (Songorwa, 1999; Kaimowitz and Sheil, 2007; Milner-Gulland and Rowcliffe, 2007).

Community-based Conservation and Institutions

This was frequently pointed out, as a practical illegal bushmeat hunting solution, by studies shown in Table 1. The conservation of wildlife resources in Tanzania can be traced as far back as the 1800s. Since then fortress conservation, dominated by the creation of core protected areas alongside the relocation of the people living in them, has been the main approach to ensure that the current and subsequent generations benefit from wildlife (Chatty and Colchester, 2002; Kideghesho, 2006). This approach failed simply because it ignored local people’s livelihoods. As a

result, in the 1970s and 1980s the country experienced a considerable drop in wildlife populations (WSRTF, 1995). Then conservationists came up with the idea of community-based conservation (CBC) aiming at striking a balance between conservation and development (Songorwa, 1999) and creating or raising conservation awareness amongst local communities (Wilfred *et al.*, 2007); which is significant in promoting wildlife as a valuable land resource (Emerton and Mfunda, 1999).

The strategy was adopted to address conflicts triggered by the isolation of people from the very natural resources on which they depend (Chatty and Colchester, 2002). Examples of human-conservation conflicts in Africa and elsewhere include poor relationship between communities and the conservation of Machalilla National Park in Ecuador (Fiallo and Jacobson, 1995). A number of human-wildlife conflicts in the Serengeti ecosystem have been highlighted by Kideghesho (2006). The relocation of people from Dwesa and Cwebe Nature Reserves in South Africa in the 1920s and 1930s not only created negative attitudes towards conservation but also resulted in the accelerated loss of species and their habitats (Fabricius and de Wet, 2002). Many countries, especially those in Africa, have instigated different participatory conservation projects (community-based wildlife management projects) in which communities around protected areas are important stakeholders (Songorwa, 1999; Wilfred, 2010). Among the often cited examples is the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe. The project ensures sustainable use of wildlife resources while improving people's livelihoods. Illegal killings of elephant and other wildlife species have been substantially reduced; because through the realisation of tangible benefits, as a result of CAMPFIRE projects, a majority of the local communities have appeared to support anti-poaching activities (Child, 1996). To reverse the trend of wildlife populations' declines mainly through poaching and loss of habitats, the government of Namibia initiated participatory conservation projects called "conservancies" in 1996 (Weaver and Skyer, 2003). These are "legally recognized, geographically defined areas that have been formed by communities who have united to manage and benefit from wildlife and other natural resources" (Weaver and Petersen, 2008). Therefore, the management of wildlife utilisation activities in conservancies is brought down to the grassroots level, with tangible benefits trickling down to local communities (Weaver and Petersen, 2008). Another good example of participatory conservation is the Community Conservation for Uganda Wildlife Authority Project (CCUWA) in Uganda. CCUWA is actively involved in the community development projects such as those related to health and educational services. It has been effective in Lake Mburo National Park where neighbouring communities realise conservation benefits and their support for conservation has increased as a result (Emerton, 1999). In Tanzania, the contemporary approach to participatory wildlife conservation has been the establishment of Wildlife Management Areas (WMAs). Although there are some challenges in their administration, some of them; for example, Ipole and Uyumbu WMAs in Tabora Region, have been somewhat successful. The WMAs offer a potentially very useful platform for addressing people's wildlife-based livelihood needs while ensuring sustainable conservation of wildlife resources (IRA, 2007; Nelson, 2007; Wilfred,

2010). However, CBC projects are said to be sustainable only if there are appropriate institutional structures to enhance people's access to natural resources and reduce conflicts (Wilfred, 2010) as institutions provide "rules of the game" (Norfolk, 2004).

Bushmeat Alternatives

Previous studies have highlighted the importance of alternatives to bushmeat in reducing wildlife poaching (Hoffer *et al.*, 1996; Loibooki *et al.*, 2002; Mfunda and Røskaft, 2010, see also Table 1). The often mentioned alternatives in these and other bushmeat literature are fish and other types of livestock (Brashares *et al.*, 2004; Rowcliffe *et al.*, 2005; Ndibalema and Songorwa, 2007), provided any challenges facing livestock keeping are adequately addressed (Brashares, 2004; Rowcliffe, 2005). Such challenges may differ from locality to locality; bringing about some variations in the livestock species accepted as viable alternatives to the bushmeat problem. For example, in northern Cameroon, domestication of guineafowl is recommended among the options for reducing bushmeat hunting (Njiforti, 1996). Poultry-keeping and fish farming are important activities for meeting animal protein demands in Brazzaville, the Republic of the Congo (Mbeté *et al.*, 2011). Feral pig *Sus scrofa* is a potentially significant livestock species in reducing pressure on wildlife in the Brazilian Pantanal (Desbiez *et al.*, 2011). A regulated local hunting of some wildlife species can also be used as a supplemental source of animal protein. This has been the case in the areas adjacent to state-protected areas in Tanzania (URT, 1974). In West Africa, local hunter associations have been useful institutions through which subsistence hunting takes place (Bassett, 2005). All the same, sustainability of any legal subsistence hunting is a paramount ingredient for successful conservation (Balduş and Caudwell, 2004).

THE FUTURE

With regard to bushmeat exploitation, the main challenge is to give OUT students, especially those working with conservation institutions in the country, the theoretical and practical skills to make a contribution straight away. This paper has revealed a number of options that would help to realise this. Most of these options require integrated approaches. For example, livestock keeping as a bushmeat hunting alternative requires (in addition to conservation knowledge) knowledge of animal husbandry. Monitoring may need a good knowledge of ecology, mapping, statistics, participatory conservation, etc.

The ecology and natural resource management course outlines/materials at the University may need to be considerably improved to keep up with modern developments in ecology and conservation biology. This might involve the creation of new courses, which are also market oriented. Such courses can address bushmeat or wildlife utilisation issues. A separate course titled say 'conservation' would also be an ideal place for intertwined issues, for example monitoring, mapping, biodiversity, community based natural resource management, modelling, metapopulations, habitats and biological invasions. A poultry production training course offered by FSTES is an excellent example. From the point of view of reducing illegal bushmeat exploitation, the course addresses practical and up to date matters pertaining local livelihoods improvement and animal protein alternatives.

The suggested amendments above are very important particularly because of the growing demand for higher education through open and distance learning. To emphasise on the expanding scope and trend of science students at OUT, a generalised linear model (GLM) with Poisson errors and a logarithm link function was used (in the statistical package GenStat Discovery Edition 4) to model the distribution and trend of the FSTES students. The information about science graduates from 2003-2011 was obtained from FSTES. Data for 2006 and 2008 were not readily available. This might have slightly altered the analysis, but not in any substantial way. The full model included OUT regional centre and year as fixed effects. Number of science graduates increased significantly from 2003 (deviance $\chi^2_1 = 174.06$, $p < 0.001$, Figure 3). The variation in graduates across regional centres was also statistically significant ($\chi^2_{21} = 21.00$, $p < 0.001$, Figure 4). Of the regions, Dar es Salaam had the highest number of graduates followed by Arusha and Mwanza, whereas Lindi was the least. Most of the bushmeat prone regions (see Table 1); for example Kigoma, Rukwa, Ruvuma, Tabora and Mara, had lower numbers of science graduates. This is probably worth keeping in mind in future.

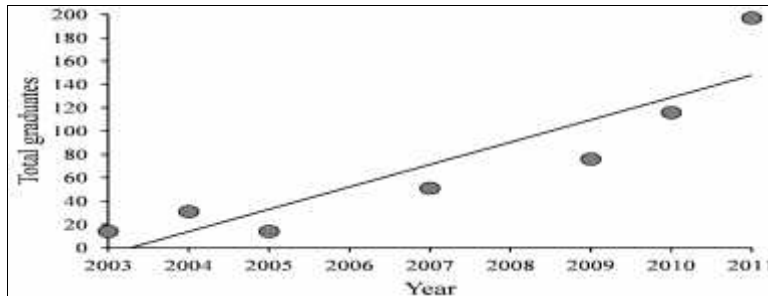


Figure 3: Time (Year) Plotted Against Science Students Graduated From 2003-2011

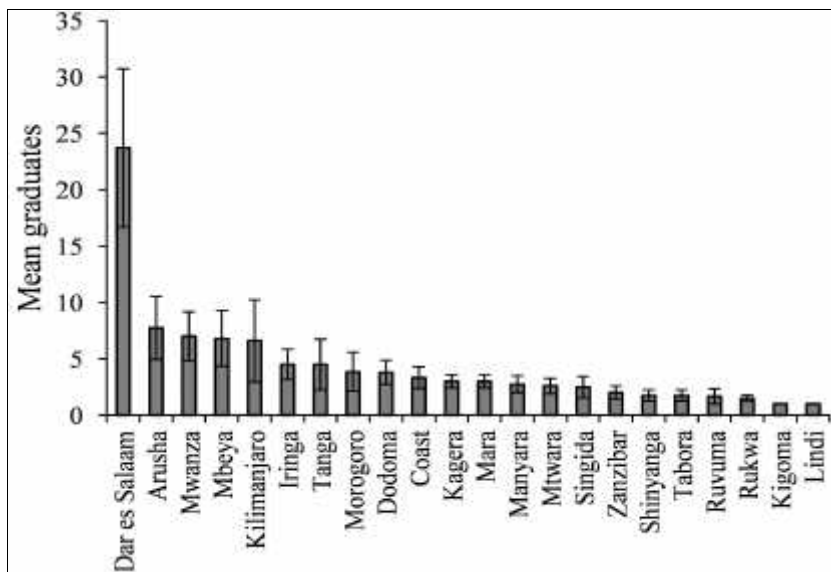


Figure 4: Mean Science Students From Different Regional Centres Graduated Between 2003-2011. Error Bars are the Standard Error of the Mean

References

- Baldus, R. D. and Hahn, R. (2009). *The Selous-Niassa Wildlife Corridor in Tanzania: Biodiversity Conservation from the Grassroots. Practical Experiences and Lessons from Integrating Local Communities into Trans-boundary Natural Resources Management*. Joint publication of FAO and CIC. Budapest. 48 pp.
- Baldus, R. D. and Cauldwell, A. E. (2004). Tourist Hunting and its Role in Development of Wildlife Management Areas in Tanzania. Unpublished Report, Dar es Salaam, Tanzania.
- Baldus, R. D. (2002). Bushmeat: Some Experiences from Tanzania. Paper presented at a Bushmeat Training Development Workshop, held at the College of African Wildlife Management (CAWM), Mweka, Kilimanjaro, 7th-9th May 2002.
- Baldus, R. D. (2008). Wildlife: can it pay its way or must it be subsidized? In: Best Practices in Sustainable Hunting: A Guide to Best Practices From Around the World (Baldus, R. D., Damm, G. R. & Wollscheid, K. U., eds.). pp. 12-16. CIC-International Council for Game and Wildlife Conservation, Hungary, www.cic-wildlife.org/fileadmin/Press/Technical_Series/.
- Baldus, R. D., Kibonde, B. And Siege, L. (2003). Seeking Conservation Partnerships in the Selous Game Reserve, Tanzania. *Parks* **13**: 50-61.
- Barrett, C. B. And Arcese, P. (1998). Wildlife Harvest in Integrated Conservation and Development Projects: Linking Harvest to Household Demand, Agricultural Production and Environmental Shocks in the Serengeti. *Land Economics* **74**: 449-465.
- Bassett, T. J. (2005). Card-Carrying Hunters, Rural Poverty, and Wildlife Decline in northern Côte d'Ivoire. *The Geographical Journal* **170**: 71-82.
- Begon, M., Townsend, C. R. and Harper, J. L. (2006). *Ecology: From Individuals to Ecosystems*. Blackwell Publishing Ltd. Oxford: UK.
- Bennett, A. F. (1999), *Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation*. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland and Cambridge: UK.
- Bennett, E. L., Blencowe, E., Brandon, K., Brown, D., Burn, R. W., Cowlshaw, G., Davies, G., Dublin, H., Fa, J. E., Milner-Gulland, E. J., Robinson, J. G., Rowcliffe, J. M., Underwood, F. M., And Wilkie, D. S. (2006). Hunting for Consensus: Reconciling Bushmeat Harvest, Conservation, and Development Policy in West and Central Africa. *Conservation Biology* **21**: 884-887.
- Brashares, J. S., Arcese, P., Sam, M. K., Coppolillo, P. B., Sinclair, A. R. E. and Balmford, A. (2004). Bushmeat Hunting, Wildlife Declines, and Fish Supply in West Africa. *Science* **306**: 1180-1183.
- Brashares, J. S., Golden, C. D., Weinbaum, K. Z., Barrett, C. B. and Okello, G. V. (2011). *Economic and Geographic Drivers of Wildlife Consumption in Rural Africa*. Proceedings of the National Academy of Sciences of the United States of America **108**: 13931–13936.
- Buckland, S. T., Anderson, D. R., Burnham, K. P. and Laake, J. L. (1993). *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, 2-6 Boundary Row, London SE1 8HN: UK.
- Campbell, K. L. I. and Loibooki, M. (2000). Game Meat Hunting in the Serengeti: a Problem of Sustainable Livelihoods. Paper presented at the Conference on

- African Wildlife Management in the New Millennium, College of African Wildlife Management, Mweka, Tanzania, 13th-15th December 2000.
- Campbell, K. L. I., Nelson, V. and Loibooki, M. (2001). *Sustainable Use of Wild Land Resources: Ecological, Economic and Social Interactions*. Main Report, Natural Resources Institute, University of Greenwich, Department of International Development: London.
- Caro, T. And Sherman, P. W. (2011). Endangered Species and a Threatened Discipline: Behavioural Ecology. *Trends in Ecology and Evolution* **26**: 111-118.
- Caro, T. (2008). Decline of Large Mammals in the Katavi-Rukwa Ecosystem of Western Tanzania. *African Zoology* **43**: 99-116.
- Carpaneto, G. M. And Fusari, A. (2000). Subsistence Hunting and Bushmeat Exploitation in Central-Western Tanzania. *Biodiversity & Conservation* **9**: 1571-1585.
- Chatty, D. and Colchester, M. (eds.) (2002). *Conservation and Mobile Indigenous Peoples: Displacement, Forced Settlement, and Sustainable Development*. New York & Oxford: Berghahn Books.
- Child, B. (1996). The Practice and Principles of Community-Based Wildlife Management in Zimbabwe: the CAMPFIRE programme. *Biodiversity & Conservation* **5**: 369-398.
- Cook, F. J. (1998). *Distance Education for Agriculture and Rural Development: The Third Wave*. Agricultural Extension and Rural Development Department (AERDD), The University of Reading, UK. <http://www.rdg.ac.uk/AcaDepts/ea/distance/third.pdf>
- Davies, G. and Brown, D. (eds.) (2007). *Bushmeat and Livelihoods: Wildlife Management and Poverty Reduction*. Blackwell Publishing Ltd. & Zoological Society of London: UK.
- de Klerk, M., Drimie, S., Aliber, M., Mini, S., Mokeona, R., Randela, R., Modiselle, S., Vogel, C., de Swart, C. and Kirsten, J. (2004). *Food Security in South Africa: Key Policy Issues for the Medium Term*. Human Sciences Research Council, Pretoria.
- Demiryürek, K. (2010). *Distance Education for Rural People in Developing Countries: YAYÇEP Experience from Turkey*. 9th European IFSA Symposium, 4-7 July 2010, Vienna, Austria. http://ifsa.boku.ac.at/cms/fileadmin/Proceeding2010/2010_WS1.7_Demiyuerek.pdf
- Desbiez, A. L. J., Piovezan, A. K. U. and Bodmer, R. E. (2011). Invasive species and Bushmeat Hunting Contributing to Wildlife Conservation: The Case of Feral Pigs in a Neotropical Wetland. *Oryx* **45**: 78-83.
- Emerton, L. and Mfunda, I. (1999), Making Wildlife Economically Viable for Communities Living Around the Western Serengeti, Tanzania. Evaluating Eden Series Discussion Paper, No. 1, International Institute for Environment and Development: London.
- Emerton, L. (1999). Balancing the Opportunity Costs of Wildlife Conservation for Communities around Lake Mburo National Park, Uganda. Evaluating Eden Series: Discussion Paper No. 5, <http://www.iied.org/pubs/pdf/full/7798IIED.pdf>.

- Fa, J. E., Currie, D. and Meeuwig, J. (2003). Bushmeat and Food Security in the Congo Basin: Linkages Between Wildlife And People's Future. *Environmental Conservation* **30**: 71-78.
- Fa, J. E., Ryan, S. F. and Bell, D. J. (2005). Hunting Vulnerability, Ecological Characteristics and Harvest Rates of Bushmeat Species in Afrotropical Forests. *Biological Conservation* **121**: 167-176.
- Fabricius, C. and de Wet, C. (2002). The Influence of Forced Removals and Land Restitutions on Conservation in South Africa. In: *Conservation and Mobile Indigenous Peoples: Displacement, Forced Settlement, and Sustainable Development* (Chatty, D. and Colchester, M., eds.). pp. 142-157. New York and Oxford: Berghahn Books.
- Fiallo, E. A. and Jacobson, S. K. (1995). Local Communities and Protected Areas, Attitudes of Rural Residents Towards Conservation and Machalilla National Park, Ecuador. *Environmental Conservation* **22**: 241-249.
- Fischer, F. (2008). The Importance of Law Enforcement for Protected Areas – Don't Step Back! Be honest – protect! *GAIA* **17**: 101-103.
- Fusari, A. and Carpaneto, G. M. (2006). Subsistence Hunting and Conservation Issues in the Game Reserve of Gile, Mozambique. *Biodiversity & Conservation* **15**: 2477-2495.
- Gebremedhin, B., Hoekstra, D. and Tegegne, A. (2006) *Commercialization of Ethiopian Agriculture: Extension Service from Input Supplier to Knowledge Broker and Facilitator*. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project working paper no 1. International Livestock Research Institute, Nairobi: Kenya.
- Gilbert, F. (2012). *Level 3 module conservation course (C13696)*. School of Biology, The University of Nottingham: UK.
- Gillingham, S. and Lee, P. C. (1999). The Impact Of Wildlife-related Benefits on the Conservation Attitudes of Local People Around the Selous Game Reserve, Tanzania. *Environmental Conservation* **26**: 218-228.
- Haule, K. S., Johnsen, F. H. and Maganga, S. L. S. (2002). Striving for Sustainable Wildlife Management: The Case of Kilombero Game Controlled Area, Tanzania. *Journal of Environmental Management* **66**: 31-42.
- Hayward, M. (2009). Bushmeat hunting in Dwesa and Cwebe Nature Reserves, Eastern Cape, South Africa. *South African Journal of Wildlife Research* **39**: 70-84.
- Hilborn, R., Arcese, P., Borner, M., Hando, J., Hopcraft, G., Loibooki, M., Mduma, S. and Sinclair, A. R. E. (2006). Effective Enforcement in a Conservation Area. *Science* **314**:1266.
- Hofer, H., Campbell, K. L. I., East, M. L. and Huish, S. A. (1996). The Impact of Game Meat Hunting on Target and Non-target Species in the Serengeti. In: *The Exploitation of Mammal Populations* (Taylor, V. J. and Dunstone, N. eds.). pp. 117-146. Chapman and Hall, London, U.K.
- Holmern, T., Johannesen, A. B., Mbaruka, J., Mkama, S. Y., Muya, J. and Røskaft, E. (2004). *Human-wildlife Conflicts and Hunting in the Western Serengeti, Tanzania*. Norwegian Institute for Nature Research, Project Report 26, Trondheim, Norway.

- Holmern, T., Muya, J. and Roskaft, E. (2007). Local Law Enforcement and Illegal Bushmeat Hunting outside the Serengeti National Park, Tanzania. *Environmental Conservation* **34**: 55-63.
- Holmern, T., Røskaft, E., Mbaruka, J., Mkama, S. Y. and Muya, D. J. (2002). Uneconomical game cropping in a community-based conservation project outside the Serengeti National Park, Tanzania. *Oryx* **36**: 364-372.
- Institute of Resource Assessment [IRA] (2007). *Assessment and Evaluation of the Wildlife Management Areas in Tanzania*. Wildlife Division, Ministry of Natural Resources and Tourism: Dar es Salaam, Tanzania.
- Jambiya, G., Milledge, S. A. H. and Mtango, N. (2007), 'Night Time Spinach': Conservation and Livelihood Implications of Wild Meat Use in Refugee Situations in North-Western Tanzania. TRAFFIC East/Southern Africa: Dar es Salaam, Tanzania.
- James, M. (2006). Metapopulations and the Sinai Baton Blue (*Pseudophilotes sinaicus* Nakamura): an introduction. *Egyptian Journal of Biology* **8**: 7-16
- Johannesen, A. B. (2005). Wildlife Conservation Policies and Incentives to Hunt: An Empirical Analysis of Illegal Hunting in Western Serengeti, Tanzania. *Environment & Development Economics* **10**:271-292.
- Kafle, G. and Balla, M. K. (2005). Participatory Wildlife Conservation Initiatives in Nepal. *Tigerpaper* **32**:11-17.
- Kahindi, O., Wittemyer, G., King, J., Ihwagi, F., Omondi, P. and Douglas-Hamilton, I. (2009). Employing Participatory Surveys to Monitor the Illegal Killing of Elephants Across Diverse Land Uses in Laikipia-Samburu, Kenya. *African Journal of Ecology* **48**: 972-983.
- Kaimowitz, D. and Sheil, D. (2007). Conserving What and for Whom? Why Conservation Should Help Meet Basic Needs in the Tropics? *Biotropica* **39**: 567-574.
- Kaltenborn, B. P., Nyahongo, J. W. and Tingstad, K. M. (2005). The Nature of Hunting Around the Western Corridor of Serengeti National Park, Tanzania. *European Journal of Wildlife Research* **51**: 213-222.
- Kideghesho, J. R. (2006). Wildlife Conservation and Local Land Use Conflicts in Western Serengeti Corridor, Tanzania. Ph.D. thesis, Department of Biology, Faculty of Natural Sciences and Technology, Norwegian University of Science and Technology.
- Kinnaird, M. F., Sanderson, E. W., O'brien, T. G., Wibisono, H. T. and Woolmer, G. (2003). Deforestation Trends in a Tropical Landscape and Implications for Endangered Large Mammals. *Conservation Biology* **17**: 245-257.
- Knueppel, D., Coppolillo, P., Msago, A. O., Msoffe, P., Mutekanga, D. and Cardona, C. (2009). *Improving Poultry Production for Sustainability in the Ruaha Landscape, Tanzania*. Report prepared for WCS TransLinks Program: Promoting Transformations by Linking Nature, Wealth and Power. USAID, Wildlife Conservation Society.
- Laurance, W. F. (2008). Theory Meets Reality: How Habitat Fragmentation Research has Transcended Island Biogeographic Theory. *Biological conservation* **141**: 1731-744.
- Leader-Williams, N. (2000). The Effects of a Century of Policy and Legal Change on Wildlife Conservation and Utilisation in Tanzania. In: *Wildlife Conservation by Sustainable Use* (Prins, H. H. T., Grootenhuis, J. G. & Dolan,

- T. T. eds.). pp. 219-245. Kluwer Academic Publishers: Boston/Dordrecht/London.
- Lindsey, P. A., Romañach, S. S., Matema, S., Matema, C., Mupamhadzi, I. and Muvengwi, J. (2011). Dynamics and Underlying Causes of Illegal Bushmeat Trade in Zimbabwe. *Oryx* **45**: 84-95.
- Loibooki, M., Hofer, H., Campbell, K. L. I. and East, M. L. (2002). Bushmeat hunting by Communities Adjacent to the Serengeti National Park, Tanzania: The Importance of Livestock Ownership and Alternative Sources of Protein and Income. *Environmental Conservation* **29**: 391-398.
- Magige, F. J., Holmern, T., Stokke, S., Mlingwa, C. and Røskaft, E. (2009). Does illegal Hunting Affect Density and Behaviour of African Grassland Birds? A Case Study on Ostrich (*Struthio camelus*). *Biodiversity and Conservation* **18**: 1361-1373.
- Marealle, W. N., Fossøy, F., Holmern, T., Stokke, B. G. and Røskaft, E. (2010). Does Illegal Hunting Skew Serengeti Wildlife Sex Ratios? *Wildlife Biology* **16**: 419-429.
- Mbete, R. A., Banga-Mboko, H., Racey, P., Mfoukou-Ntsakala, A., Nganga, I., Vermeulen, C., Doucet, J. L., Hornick, J. L. and Leroy, P. (2011). Household Bushmeat Consumption in Brazzaville, Republic of the Congo. *Tropical Conservation Science* **4**: 187-202.
- McNeely, J. A. and Scherr, S. J. (2001). *Common Ground, Common Future: How Eco-Agriculture can Help Feed the World and Save Wild Biodiversity*. IUCN, Future Harvest: Washington, D.C.
- Mesterton-Gibbons, M. and Milner-Gulland, E. J. (1998). On the Strategic Stability of Monitoring: Implications for Cooperative Wildlife Management Programmes in Africa. *Proceedings of the Royal Society of London B* **265**: 1237- 1244.
- Mfunda, I. M. and Røskaft, E. (2010). Bushmeat Hunting in Serengeti, Tanzania: An Important Economic Activity to Local People. *International Journal of Biodiversity and Conservation* **2**: 263-272.
- Milner-Gulland, E. J. and Akçakaya, H. R. (2001). Sustainability Indices for Exploited Populations. *Trends in Ecology & Evolution* **16**: 686-692.
- Milner-Gulland, E. J. and Rowcliffe, J. M. (2007). *Conservation and Sustainable Use: A Handbook of Techniques*. Oxford University Press: Oxford.
- Mkpado, M. and Onuoha, R. E. (2008). Refined Indigenous Knowledge as Sources of Low Input Agricultural Technologies in Sub-Saharan Africa Rural Communities. *International Journal of Rural Studies* **15**: 2-8.
- Mundia, C. N. and Murayama, Y. (2009). Analysis of Land Use/Cover Changes and Animal Population Dynamics in a Wildlife Sanctuary in East Africa. *Remote Sensing* **1**: 952-970.
- Naranjo, E. J. and Bodmer, R. E. (2007). Source-sink Systems and Conservation of Hunted Ungulates in the Lacandon Forest, Mexico. *Biological Conservation* **138**: 412-420.
- Nasi, R., Brown, D., Wilkie, D., Bennett, E., Tutin, C., van Tol, G., and Christophersen, T. (2008). *Conservation and Use of Wildlife-Based Resources: The Bushmeat Crisis*. CBD Technical Series Number 33. Secretariat of the Convention on Biological Diversity, Montreal, Canada, and Centre for

- International Forestry Research, Bogor, Indonesia, www.cbd.int/doc/publications/cbd-ts-33-en.pdf.
- Ndibalema, V. G. and Songorwa, A. (2007). Illegal Meat Hunting in Serengeti: Dynamics in Consumption and Preferences. *African Journal of Ecology* **46**:311-319.
- Ndibalema, V. G. (2009). A Comparison of Sex Ratio, Birth Periods and Calf Survival Among Serengeti Wildebeest Sub-populations, Tanzania. *African Journal of ecology* **47**: 574-582.
- Nelson, F. (2007). *Emergent or Illusory? Community Wildlife Management in Tanzania*. International Institute for Environment and Development (iied), 3 Endsleigh Street, London WC1H 0DD, UK, <http://pubs.iied.org/pdfs/12540IIED.pdf>.
- Nielsen, M. R. (2006). Importance, Cause and Effect of Bushmeat Hunting in the Udzungwa Mountains, Tanzania: Implications for Community Based Wildlife Management. *Biological Conservation* **128**: 509-516.
- Nielsen, M. R. (2011). Improving the Conservation Status of the Udzungwa Mountains, Tanzania? Effect of Joint Forest Management on Bushmeat Hunting in the Kilombero Nature Reserve. *Conservation & Society* **9**(2): 106-118.
- Njiforti, H. L. (1996). Preferences and Present Demand for Bushmeat in North Cameroon: Some Implications for Wildlife Conservation. *Environmental Conservation* **23**: 149-155.
- Norfolk, S. (2004). *Examining Access to Natural Resources and Linkages to Sustainable Livelihoods. A case study of Mozambique*. FAO, Livelihood Support Programme.
- Norgrove, L. and Hulme, D. (2006). Confronting Conservation at Mount Elgon, Uganda. *Development & Change* **37**: 1093-1116.
- Novaro, A. J., Funes, M. C. and Walker, R. S. (2005). An Empirical Test of Source – Sink Dynamics Induced by Hunting. *Journal of Applied Ecology* **42**: 910-920.
- Nyahongo, J. W., Holmern, T., Kaltenborn, B. P. and Røskaft, E. (2009). Spatial and Temporal Variation in meat and Fish Consumption among People in the Western Serengeti, Tanzania: The Importance of Migratory Herbivores. *Oryx* **43**: 258-266.
- Olupot, W., McNeilage, A. J. and Plumtre, A. J. (2009). An Analysis of Socioeconomics of Bushmeat Hunting at Major Hunting Sites in Uganda. Wildlife Conservation Society (WCS) Working Paper No. 38, WCS Working Papers, ISSN 1530-4426, www.wcs.org/science.
- Pimbert, M. P. and Pretty, J. N. (1995), *Parks, People and Professionals: Putting 'Participation' into Protected Area Management*. UNRISD Discussion Paper 57. United Nations Research Institute for Social Development, Geneva.
- Redford, K. H. (1992). The empty forest. *BioScience* **42**:412-422.
- Rist, J., Rowcliffe, M., Cowlishaw, G. and Milner-Gulland, E. J. (2008), Evaluating Measures of Hunting Effort in a Bushmeat System. *Biological Conservation* **141**: 2086-2099.
- Roth, H. H. and Merz, G. (eds.) (1997). *Wildlife Resources: A Global Account of Economic Use*. Springer-Verlag: Berlin.

- Rowcliffe, J. M., Milner-Gulland, E. J. and Cowlshaw, G. (2005). Do Bushmeat Consumers Have Other Fish to Fry? *Trends in Ecology & Evolution* **20**: 274-276.
- Scherr, S. J. and McNeely, J. A. (2008). Biodiversity Conservation and Agricultural Sustainability: Towards a New Paradigm of 'Ecoagriculture' Landscapes. *Philosophical Transactions of the Royal Society of London. Series B, Biological sciences* **363**: 477-494
- Setsaas, T., Holmern, T., Mwakalebe, G., Stokke, S. and Røskaft, E. (2007). How does Human Exploitation Affect Impala Populations in Protected and Partially Protected Areas? – A Case Study from the Serengeti Ecosystem, Tanzania. *Biological Conservation* **136**: 563-570.
- Severre, E. L. M. (2003). *Community Tourism Gateway to Poverty Reduction: Community Tourism-Wildlife Interface*. International Institute for Peace Through Tourism (IIPT), Second IIPT African Conference on Peace Through Tourism, Dar es Salaam, Tanzania.
- Shigesada, N. and Kawasaki, K. (1997). *Biological Invasions: Theory and Practice*. Oxford University Press, 205 pp.
- Shivji, I. (2001). Village Governance and Common Pool Resources in Tanzania. Unpublished project discussion paper, <http://www-cpr.cam.ac.uk>.
- Shrestha, R. K. and Alavalapati, J. R. R. (2006). Linking Conservation and Development: Analysis of Local People's Attitude Towards Koshi Tappu Wildlife Reserve, Nepal. *Environment, Development & Sustainability* **8**: 69-84.
- Smith, T. M., and Smith, R. L. (2009), *Elements of Ecology (Seventh Edition)*. Pearson Benjamin Cummings: San Francisco.
- Songorwa, A. N. (1999). Community-based Wildlife Management (CWM) in Tanzania: are the Communities Interested? *World Development* **27**: 2061-2079.
- Stavriniadis, M. and Anayiotos, P. (2006). Integrative Wildlife and Habitat Management: Problems and Sustainable Solutions in Cyprus. "Landscape Management and its Impacts on Wildlife – Opportunities for Cyprus" 29/04/2006, http://www.cic-wildlife.org/fileadmin/Commissions_WG/habitat_fallow_land/WMA_Symposium/M.Stavriniadis_P.Anayiotos_Presentation.pdf.
- Taylor, V. J. and Dunstone, N. (eds.) (1996). *The Exploitation of Mammal Populations*. Chapman & Hall: London, UK.
- Topp-Jørgensen, E., Nielsen, M. R., Marshal, A., Pedersen, U. (2009). Mammalian Density in Response to Different Levels of Bushmeat Hunting in the Udzungwa Mountains, Tanzania. *Tropical Conservation Science* **2**: 70–87.
- United Republic of Tanzania [URT] (1974). *The Wildlife Conservation Act No. 12 of 1974*. Government Printer, Dar es Salaam, Tanzania.
- URT (2006). National Adaptation Programme of Action (NAPA) for Tanzania, www.databases.sardc.net.
- Weaver, L. C. and Petersen, T. (2008). Namibia Communal Area Conservancies. *Best Practices in Sustainable Hunting*: 48-52.
- Weaver, L. C. and Skyer, P. (2003). Conservancies: Integrating Wildlife Land-Use Options into the Livelihood, Development, and Conservation Strategies of Namibian Communities. Paper presented at the 5th World Parks Congress to the Animal Health and Development (AHEAD) Forum, Durban, South Africa.

- Weinberg, A. C. (1990). Low-input Agriculture Reduces Nonpoint-source Pollution. *Journal of Soil & Water Conservation* **45**: 48-50.
- Wildlife Sector Review Task Force [WSRTF] (1995). *A Review of the Wildlife Sector in Tanzania Volume 1: Assessment of the Current Situation*. Ministry of Tourism, Natural Resources and Environment, Dar es Salaam, Tanzania.
- Wilfred, P. and MacColl, D. C. (2010). Income Sources and their Relation to Wildlife Poaching in Ugalla Ecosystem, Western Tanzania. *African Journal of Environmental Science and Technology* **4**: 886-896.
- Wilfred, P. (2010). Towards Sustainable Wildlife Management Areas in Tanzania. *Tropical Conservation Science* **3**: 103-116.
- Wilfred, P., Madoffe, S. S. and Luoga, E. J. (2007). Role of Institutions in Biodiversity Conservation in Northern Uluguru Mountains, Morogoro, Tanzania: the villagers' perspective. *Discovery & Innovation* **19**: 15-24.
- Willcox, A. S. and Nambu, D. M. (2007). Wildlife Hunting Practices and Bushmeat Dynamics of the Banyangi and Mbo People of Southwestern Cameroon. *Biological Conservation* **134**: 251-261.
- Young, J., Watt, A., Nowicki, P., Alard, D., Clitherow, J., Henle, K., Johnson, R., Laczko, E., McCracken, D., Matouch, S., Niemela, J. and Richards, C. (2005). Towards Sustainable Land Use: Identifying and Managing the Conflicts between Human Activities and Biodiversity Conservation in Europe. *Biodiversity & Conservation* **14**:1641-1661.