Provisioning of Game Meat to Rural Communities as a Benefit of Sport Hunting in Zambia

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Abstract

Sport hunting has reportedly multiple benefits to economies and local communities; however, few of these benefits have been quantified. As part of their lease agreements with the Zambia Wildlife Authority, sport hunting operators in Zambia are required to provide annually to local communities free of charge i.e., provision a percentage of the meat obtained through sport hunting. We characterized provisioning of game meat to rural communities by the sport hunting industry in Zambia for three game management areas (GMAs) during 2004–2011. Rural communities located within GMAs where sport hunting occurred received on average > 6,000 kgs per GMA of fresh game meat annually from hunting operators. To assess hunting industry compliance, we also compared the amount of meat expected as per the lease agreements versus observed amounts of meat provisioned from three GMAs during 2007–2009. In seven of eight annual comparisons of these GMAs, provisioning of meat exceeded what was required in the lease agreements. Provisioning occurred throughout the hunting season and peaked during the end of the dry season (September–October) coincident with when rural Zambians are most likely to encounter food shortages. We extrapolated our results across all GMAs and estimated 129,771 kgs of fresh game meat provisioned annually by the sport hunting industry to rural communities in Zambia at an approximate value for the meat alone of > US$600,000 exclusive of distribution costs. During the hunting moratorium (2013–2014), this supply of meat has halted, likely adversely affecting rural communities previously reliant on this food source. Proposed alternatives to sport hunting should consider protein provisioning in addition to other benefits (e.g., employment, community pledges, anti-poaching funds) that rural Zambian communities receive from the sport hunting industry.
Introduction

Sport hunting in Africa represents an important form of revenue-generating tourism [1], [2]. Additional reported benefits include conservation of biodiversity through protection of large tracts of land that might otherwise be converted to agricultural or domestic livestock use [3–7] and selective hunting of potentially dangerous or destructive species that can increase local people’s tolerance for coexistence [8–10]. However, others report that sport hunting contributes little to rural economies or livelihoods [11].

Employment, revenues from hunting fees and licenses, contributions to community capital projects, and funding of anti-poaching scouts are potential benefits that rural communities may receive from sport hunting [12], [13]. Access to game meat has been described as the most tangible benefit to rural communities [14]; however, comparatively little effort has been made to characterize meat provisioning. Notable exceptions are Namibian communal conservancies that report annually on game meat revenues attributable to sport hunting [15], and the comprehensive summary of game meat distributions in Africa compiled by TRAFFIC which considered sport hunting in addition to game ranching and culling [14]. In Zambia, a 1971 report based on household surveys estimated that sport hunting provided 112 tonnes of dressed game meat to rural Zambians countrywide [16] (cited in [12]). We are unaware of more recent studies in Zambia, including studies that quantified provisioning at the GMA scale. In addition, we found no record of previous attempts to examine the patterns or scope of meat distributions.

Food security in developing nations is a primary focus of aid organizations worldwide [17–21]. In Zambia, 48% of the population was undernourished in 2012–2014 [22] and 19% of Zambian households were recently classified as chronically food insecure [20] defined as a continuously inadequate diet caused by the inability to acquire food [23]. Food shortage is defined as an individual receiving less than 2,200 kilocalories per day [18]. Donor aid programs provide supplemental food typically consisting of maize, sorghum, or other cereals. Although high-protein cereals are being developed [24], at present recommended daily protein requirements (50 gm/day) [25] are rarely met in Zambia [22], [26].

As part of their official lease agreements with the Zambia Wildlife Authority (ZAWA), sport hunting operators in Zambia are required to provide to rural communities a proportion of game animals harvested by clients each year. This meat is distributed free of charge to villages that reside within game management areas (GMAs) where sport hunting occurs. To legally obtain protein outside of GMAs, rural Zambians must raise their own livestock, fish, or purchase meat. Livestock husbandry is costly and precluded in some areas due to diseases [27], inadequate grazing, or presence of tsetse flies Glossina spp. [28]. To fish legally requires purchasing a permit and access to lakes, rivers, or seasonal ponds. Purchasing meat is expensive: about US$10/kg for beef, US$7/kg for chicken, and US$15/kg for dried fish (i.e., kapenta Limnothrisa sp.). Most (64%) Zambians live on less than US$1.00/day [29]. Thus, high expense makes obtaining animal protein cost prohibitive for most rural Zambians.

Obtaining sufficient amounts of protein is a widespread problem faced by rural people in many parts of Africa. Alternatives for meeting the protein requirements are being explored in other countries. In particular, game ranching, communal conservancies [30], [31], and other forms of community-based wildlife conservation programs [32] show promise. However, despite a few earlier attempts, these programs in Zambia are limited in scope, highly localized, and poorly developed [14], meaning that currently most rural Zambians do not have access to meat through these means.

Presently, the only other alternative for rural Zambians to obtain meat is illegally through poaching of wild animals or purchase of poached meat (herein referred to as bushmeat). Global concerns over the prevalence and extent of bushmeat poaching are increasing rapidly [33], [34].
Studies cite the unsustainable nature of the bushmeat trade [34] and the loss of potential income that results from poaching compared to the value of the same animals to photographic tourism or sport hunting [35].

We quantified the annual provisioning of fresh game meat by the sport hunting industry to rural communities in Zambia. Specifically, we characterized the expected and observed amounts of meat provisioned and the timing and spatial extent of meat distributions to rural communities. Finally, we discuss meat provisioning in the context of rural livelihoods, in particular food security and bushmeat poaching, in relation to Zambia’s 2013–2014 hunting moratorium.

Methods

Zambia Wildlife Authority ranks GMAs as prime, secondary, or understocked based on species occurrence and animal abundance [36]. Prime GMAs include species that are fairly abundant and include highly valued trophies (e.g., African lion Panthera leo, leopard P. pardus, roan antelope Hippotragus equinus, and sable antelope H. niger) and that can accommodate five or more classical safaris and seven or more mini safaris per hunting season. Secondary GMAs include species less abundant but that generally can sustain three to four classical safaris and a minimum of five mini safaris per hunting season. Understocked GMAs contain species assemblages that are intact but with populations low enough that no hunting quota or only a minimum hunting quota is allowed [37]. Quotas are set annually for each GMA based on their ranking, an evaluation of the hunting operators’ performance in the GMA during the previous season, and input from regional ZAWA scouts, ZAWA ecologists and representatives of the rural communities located within the GMAs. We obtained quotas from 2007 to 2009 from ZAWA for each of 30 GMAs in Zambia where sport hunting occurred. These 30 GMAs cover 84,033km² and represent 11% of Zambia’s total land area. We excluded non-edible trophy species (African lion, leopard, spotted hyena Crocuta crocuta, Nile crocodile Crocodylus niloticus, small carnivores, and primates) from all calculations.

Sport hunting operators in each GMA are mandated by their lease agreements to utilize (i.e., hunt) ≥ 60% of their annual quota and distribute ≥ 50% of all game animals harvested each year to rural communities located in the GMA where the hunting occurred. Thus, 60% of the allocated quota of game species represents the estimated minimum number of edible animals harvested annually by sport hunters in Zambia; half of which represents the minimum amount of game meat that communities may expect to receive in a given year.

We collected data on meat provisioning from three GMAs (1 prime, 1 secondary, 1 understocked). During the study, each GMA was operated by individual hunting companies under a ten-year (2002–2012) lease agreement with ZAWA and the local communities. Zambia’s sport hunting season occurred each year from 1 May to 31 December; however, sport hunting declines during the hottest months (mid-October to early November) and is typically discontinued when the rainy season begins in late November (P. White, personal observation).

We used reported live [38] and dressed weights [25] of game species to estimate harvested biomass. We used body weights for subspecies that occurred in Zambia when available. For species whose dressed weights were not available, we used conversion rates from a closely related species within the same genus. Reported dressed weights excluded offal; however, rural Zambians routinely consume organ meats (e.g., heart, liver, kidneys) in addition to skeletal muscle and bones which are boiled for additional nutrition (P. White, personal observation). Thus, dressed carcass weights represent minimum estimates of the amount of edible meat.

For each of the three GMAs sampled, we calculated the annual amount of meat expected through provisioning during 2007–2009 (data for 2008–2009 only were available for the
understocked GMA). We converted the number and species of animals represented by 50% of the utilized quota to kgs using the same dressed weight calculations as were applied to meat distribution logs (below). We also estimated the expected mean annual amount of meat provisioned in all GMAs where sport hunting occurred during 2007–2009. We excluded GMAs not hunted during the previous lease period, specialized GMAs, private game ranches, and conservancies. We used 60% of the allocated quotas at 50% distribution and converted these values to dressed weights to estimate the total kgs of meat expected to be provisioned countrywide.

We estimated the amount of meat provisioned annually during the 2005–2011 hunting seasons for the sampled prime and secondary GMAs and for five seasons during 2004–2011 for the understocked GMA. We obtained this information from meat distribution logs provided to ZAWA by hunting operators. Logs included date, species, portion of carcass distributed (e.g., half, whole), and generally a description of the recipient location (e.g., name of village, clinic, school, game scout post). Each log entry represented one animal or portion of an animal distributed to one location as verified by signature of the receiving party. We calculated dressed weights (kgs) from species and amount of provisioned meat as described previously.

To assess performance of the sport hunting industry in meeting its meat provisioning requirements, we compared annual expected and observed amounts (kgs) of provisioned meat in the three sampled GMAs during 2007–2009. We also summarized the amount (kgs) of meat provisioned and number of distribution events by month and year. When possible, we determined locations of distribution events using Google Earth, survey charts, and 1:250,000 scale topographic maps (Surveyor General, Lusaka, Zambia) and estimated distances from the recipients' locations to the provisioning hunting camp to determine the spatial extent of meat provisioning.

We used generalized linear mixed-effects models in program R (version 3.0.2; R Development Core Team 2013) [39] to estimate differences in response variables among GMAs and months. Response variables were the amount of meat provisioned and number of distribution events; explanatory variables were GMA and month. We included year as a random effect. We used least-squares difference means tests to compare differences among GMAs and months. We report means with ± 1 standard deviation and set statistical significance at \( \alpha = 0.05 \).

**Results**

Mean expected annual amount (kgs) of meat distributed countrywide was 129,771 ± 15,862 kgs during 2007–2009, representing 2,359 ± 320 individual animals of 20 species (Table 1). The mean expected annual amount of meat provisioned from 2007 to 2009 was greater for the prime (6187.3 ± 262.1 kgs) and secondary (5810.0 ± 248.6 kgs) GMAs than for the understocked (1204.0 ± 0 kgs) GMA. Similarly, the observed amount of meat provisioned annually during 2004–2011 varied among GMAs (\( F_{2,16} = 21.97, P < 0.001 \)), with the prime (5832.1 ± 1579.9 kgs; \( n = 7 \)) and secondary (6495.0 ± 1876.1 kgs; \( n = 7 \)) GMAs provisioning greater (\( P < 0.05 \)) amounts of meat than the understocked (973.4 ± 390.3 kgs; \( n = 5 \)) GMA. Considering paired 2007–2009 data only, the observed amounts (kgs) of meat provisioned in prime and secondary GMAs exceeded what was expected each year (Fig. 1). In the understocked GMA, observed amounts exceeded expectations in one of two years.

The mean annual number of distribution events varied among GMAs (\( F_{2,16} = 17.32, P < 0.001 \)), with more distribution events (\( P < 0.05 \)) in the prime GMA (39.3 ± 8.7) than in the secondary (24.9± 8.9) and understocked (13.8 ± 8.1) GMAs. Annual number of distribution events in the secondary and understocked GMAs were similar (\( P > 0.05 \)). The timing of distributions varied across months (\( F_{5,95} = 7.13, P < 0.001 \)) with more distribution events during
July and September and fewer during May (Fig. 2). There was no interaction between GMA and month ($F_{10,95} = 1.32, P = 0.233$).

The observed amount (kgs) of meat provisioned each month varied among GMAs ($F_{10,95} = 1.24, P = 0.277$) with greater amounts of meat provisioned from the prime and secondary

![Fig 1. Expected versus observed amounts (kgs) of meat provisioned in each of three Game Management Areas (GMA), Zambia.](https://doi.org/10.1371/journal.pone.0117237.g001)
GMAs than from the understocked GMA ($P < 0.05$; Fig. 3). Overall, mean total amounts (kgs) of meat provisioned were greatest in September and least in May ($F_{5,95} = 6.15, P < 0.001$). There was no interaction between GMA and month ($F_{10,95} = 1.32, P = 0.233$). In the prime GMA, mean meat provisioning in July and September exceeded 1,700 kgs/month. In the secondary GMA, mean monthly provisioning was 1,800 kgs in September and exceeded 1,250 kgs/month during July–October. The greatest mean monthly amount of meat provisioned in the understocked GMA was in September ($> 400$ kgs).

Distribution logs contained locations of meat recipients in 62% ($n = 518$) of entries, including 63% ($n = 275$) in the prime GMA, 78% ($n = 174$) in the secondary GMA, and 16% ($n = 69$) in the understocked GMA. Remaining entries were received by community-appointed liaison officers who oversaw onward distribution. To assess the spatial extent of meat provisioning, we determined specific locations for 336 distribution events in relation to the locations of hunting camps that supplied the meat. Meat provisioning extended to $> 50$ km from sport hunting camps with most (70%) occurring within 20 km of camps (Fig. 4).

**Discussion**

In Zambia, provisioning of fresh game meat by sport hunting operators constituted an important source of protein for rural communities, with actual meat provisioned exceeding 6,000 kgs annually in the sampled prime and secondary GMAs. Meat provisioning by the hunting industry appeared reliable across years and exceeded expectation in each GMA and in every year
except one (understocked GMA in 2009). Variations in the amount and timing of distributions appeared influenced in part by unpredictable short-term perturbations. For example, eruption of the Icelandic volcano and subsequent disruption to international flights in 2010 [40] caused the abrupt cancellation of numerous hunts and lowered the amount of meat distributed in some months that year (PHAZ, personal communication).

The provisioning of greater amounts of meat than expected resulted when operators successfully hunted more than the minimum 60% required of their annually allocated quota (P. White, unpublished data). These results illustrate a potential conflict of interest; ZAWA receives revenues based on GMA ranking (prime GMAs carry the highest fees) as well as the number of animal licenses sold. Therefore, ZAWA could be motivated to rank GMAs as high as possible and to allocate larger quotas in order to receive greater revenues from hunting operators [37]. Local communities also receive a portion of each animal license fee, and receive more meat when allocated quotas are high, especially for large-bodied species. Thus, community representatives engaged in quota setting exercises may also be motivated to support high quotas.

Likewise, hunting operators may be motivated to sell as many hunts as possible each year to maximize profits, especially in prime GMAs where fees are greater. However, an operator’s future success is gauged on quality of trophies obtained in previous years. Trophy quality is judged on size and age rather than number of animals shot [41]. Further, lease periods of ≥ 10 years help promote good stewardship because holders of longer-term leases have a vested interest in conserving wildlife populations [42]. Zambian Wildlife Authority requirements of a minimum annual harvest could promote shooting of immature animals if allocated quotas are excessive. Despite existing protocols for post-season meetings designed to set quotas in accordance with best available information, allocated quotas are subject to later change by ZAWA’s head office sometimes without consulting regional ecologists, hunting operators, or local communities. Subsequently, hunting operators occasionally request reduced quotas for certain species if they believe the allocated quota to be excessive in their GMA (PHAZ, personal communication). A more standardized methodology for monitoring trends in game population abundance, preferably including estimates of precision, could simplify setting of quotas and help ensure sustainable harvest.

The amount of meat and frequency of meat distributions was generally greater during months (e.g., September) when rural people are most likely to experience food shortages i.e., when alternative sources of food are exhausted and prior to annual crop production [43]. With a hunting moratorium in place since January 2013 throughout most of Zambia’s GMAs, game meat supplied by the sport hunting industry has been almost eliminated. Over 60% of Zambia’s
human population was classified as rural in 2013 and 83% of rural Zambian households are poor [44]. Most (20 of 30) of the GMAs analyzed in this study are in three of Zambia’s poorest and most remote provinces (Northwestern, Eastern, and Southern) [44]. Zambia’s poorest families whose crop production is insufficient to support themselves rely on income from casual labor to purchase food during shortages [43]. Food is the largest expenditure for Zambia’s rural poor [45] for whom casual labor constitutes a major source of income [46]. However, most employment opportunities provided by sport hunting camps each year were lost during the current moratorium. This included casual work (road clearing, camp building) as well as seasonal jobs that lasted throughout the hunting season (camp staff, trackers and skinners, drivers and mechanics, etc.). In addition, commodities normally purchased by hunting camps from local communities (e.g., thatching grass, vegetables, maize meal) were not needed (P. White, unpublished data). Thus, in addition to the loss of provisioned meat, many rural people may lack the financial resources to legally purchase meat. During the similar time period (February 2013–February 2014) inflation in Zambia increased 7.6% [47]. The rate of inflation has since increased to 8.1% (November 2013–November 2014) with the cost of food contributing the most to the annual increase [48]. Zambia’s poorest provinces have experienced the highest inflation rates countrywide [48].

In the absence of sport hunting, rural communities need alternatives to reliably and legally obtain meat. Solutions must be appropriate to local situations however [34], and consider the needs of humans and wildlife to avoid adverse effects [49–51]. Domestic livestock are excluded from many parts of Zambia due to tsetse flies [28] and can cause habitat degradation if overstocked [52]. Game ranching can provide a source of meat and African game meat has a greater protein content (> 20% per 100g) than domestic species (< 20% per 100g) [25]. But whereas sport hunting operators provision free meat as part of their lease agreements, ranchers may expect fair or subsidized prices for their product [53]. A shift to greater reliance on wild fisheries can result in depletion of fish stocks [33]; Zambia’s native fish stocks are showing evidence of severe depletion [54],[55]. Communal conservancies that incorporate game and domestic stock could provide rural people with protein and income. These programs require considerable start-up investment and maintenance and a sport hunting component is often needed to ensure success, especially in the early stages [56],[57]. The most profitable conservancies include a sport hunting component [7],[15]; however, the income received by individuals is inversely related to human population density [10]. Benefits to residents diminish when conservation-benefit programs result in an influx of immigrants seeking to share in returns [58],[59].

Where alternative sources of food and income are not available, incidents of bushmeat poaching increase during the late dry season [35],[60],[61]. Many hunters sell bushmeat to obtain cash to purchase other foods [34], material goods [60], or to enhance their farming efforts thereby increasing the income potential of their crops [62]. Whether hunting for food or cash, expanding human populations coupled with the unsustainable hunting methods favored by bushmeat poachers have caused widespread concerns for the viability of wildlife populations and entire species [34],[63],[64]. Studies of bushmeat hunters in Zambia [60] and buyers in Zimbabwe [53] concluded that increasing the supply of free meat would help reduce bushmeat poaching.

Those most dependent on bushmeat for food are often the most remote and marginalized groups [33],[34],[49]. In Zambia, poor families are more likely to live ≥ 20 km from the nearest markets than families that are not poor [45]. Most of Zambia’s GMAs are located in the poorest and most remote provinces [44]. Sport hunting operators in Zambia provisioned meat to at least 50 km from their hunting camps, which were situated in remote areas on average 84 km from the nearest towns (N = 32 camps). While the price of bushmeat can vary with distance to
average cost of bushmeat in Zambia in 2012 was US$4.75/kg of fresh game meat (P. White, unpublished data). Thus, the estimated replacement cost of game meat exceeds US$27,700/year for each prime GMA, US$30,850/year for each secondary GMA, and US$4,620/year for each understocked GMA. Countrywide, the estimated annual cost to purchase the equivalent of 129,771 kgs of fresh game meat is US$616,412, excluding butchering and delivery costs. At > 20% protein per 100g game meat, this is equivalent to 519,084 people days of protein per year. This figure is based on the recommended daily protein requirement of 50 gm/day [25] being fulfilled entirely by animal protein. In fact, Zambians on average obtain less than 20% of their dietary energy from animal protein [66]. Thus, although meat provisioned by sport hunting operators represents a small percentage of protein requirements for Zambians, it appears an effective means of distributing fresh, high quality meat to some of the most remote areas of the country with the greatest protein needs, thereby partially alleviating protein deficiencies in rural Africans. Elsewhere in Africa (e.g., Selous Game Reserve, Tanzania) where communities may be located too far from sport hunting camps to facilitate distribution of fresh meat, alternative sources of protein may be required.

The recent moratorium on sport hunting throughout much of Zambia created a crisis situation [67]. Bushmeat poaching is a serious problem in Zambia [14],[37] and the severity and rate of poaching has escalated during the current hunting closure [68]. Similarly, accelerated loss of wildlife occurred during previous (2000–2002) hunting closures in Zambia [4] and elsewhere (Kenya [9],[69]). Zambia’s human population continues to increase (2.8% in 2010) [70]. From 1987–1997, Zambia’s wildlife sector underperformed with regards its potential to supply game meat to rural people [14]. This included game ranching and cropping schemes in addition to sport hunting.

We characterized and quantified meat provisioning in Zambia. Large-scale sport hunting also occurs in the African countries of Namibia, Mozambique, Tanzania and Zimbabwe. In all five countries, over 60% of the total population is rural, with at least 25% of the population in each country categorized as undernourished [22]. With the exception of Namibia, each of these countries has lower than average GDPs compared to the mean for all African countries [71]. Globally, Zambia, Mozambique and Tanzania each rank in the bottom 20 of food supply of meat [66]. As in Zambia, most hunting areas in these other four countries are located in rural regions [72]. National governments and wildlife authorities are responsible for establishing hunting quotas and lease agreements including meat distribution requirements, thus extrapolation of meat provisioning in Zambia to other countries would be speculative, and wider-scale estimates are beyond the scope of this paper. However, the detailed information we provide for Zambia may serve as a template for future investigations of expected meat distributions in other countries or regions where hunting occurs.

While the amount of game meat provisioned annually by Zambia’s sport hunting industry is substantial, a multi-use approach that incorporates sport hunting, game ranching, and communal conservancies for additional sources of protein and income in rural areas will likely be required to keep pace with the growing demand for meat and jobs. It is vital that Zambia’s GMAs be afforded sound custody unless and until viable alternatives offering the same or greater benefits than sport hunting provided can be implemented.

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Author Contributions
Conceived and designed the experiments: PAW. Performed the experiments: PAW. Analyzed the data: PAW JLB. Contributed reagents/materials/analysis tools: JLB. Wrote the paper: PAW JLB.

References
1. Booth VR (2009) A comparison of prices of hunting tourism in Southern and Eastern Africa. Budapest, Hungary: Joint Publication of FAO and CIC. 40 p. PMID: 25506961
2. Barnett R, Patterson C (2005) Sport hunting in the Southern African development community (SADC) region: An overview. Johannesburg, South Africa: TRAFFIC East/Southern Africa. 116 p. PMID: 25275211
3. Lewis D, Alpert P (1997) Trophy hunting and wildlife conservation in Zambia. Conservation Biology 11: 59–68.
4. Lewis DJ, Jackson JJ (2005) Safari hunting and conservation on communal land in southern Africa. In: Woodroffe R, Thirgood S, Rabinowitz A, editors. People and wildlife: Conflict or coexistence? Cambridge, UK: Cambridge University Press. pp. 239–251.
5. Lindsey PA, Alexander R, Frank LG, Mathieson A, Romanach SS (2006) Potential of trophy hunting to create incentives for wildlife conservation in Africa where alternative wildlife-based land uses may not be viable. Animal Conservation 9: 283–291.
6. Lindsey PA, Roulet PA, Romanach SS (2007) Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. Biological Conservation 134: 455–469. PMID: 17709564
7. Loveridge AJ, Reynolds JC, Milner-Gulland EJ (2007) Does sport hunting benefit conservation? In: Macdonald D, Service K, editors. Key topics in conservation biology. Maiden, Massachusetts: Blackwell Publishing Ltd. pp. 222–238.
8. Bond I (1994) Importance of elephant hunting to CAMPFIRE revenue in Zimbabwe. TRAFFIC Bulletin 14: 117–119.
9. Norton-Griffiths M (1998) The economics of wildlife conservation policy in Kenya. In: Milner-Gulland E, Mace R, editors. Conservation of biological resources. Oxford, UK: Blackwell Science. pp. 279–293.
10. Leader-Williams N, Hutton JM (2005) Does extractive use provide opportunities to offset conflicts between people and wildlife? In: Woodroffe R, Thirgood S, Rabinowitz A, editors. People and wildlife: Conflict or coexistence? Cambridge, UK: Cambridge University Press. pp. 140–161.
11. Campbell R (2013) The $200 million question: how much does trophy hunting really contribute to African communities? A report for the African Lion Coalition. Melbourne, Australia: Economists at Large. doi: 10.1007/s13197-013-0993-z PMID: 25593984
12. Astle WL (1999) A history of wildlife conservation and management in the mid-Luangwa valley, Zambia. Bristol, UK: British Empire and Commonwealth Museum. 149 p. PMID: 25506965
13. Jackson JJ (1996) An international perspective on trophy hunting. In: Leader-Williams N, Kayera JA, Overton GL, editors. Tourist hunting in Tanzania. Gland, Switzerland and Cambridge, UK: IUCN. pp. 7–11.
14. Barnett R (1997) Food for Thought: The utilization of wildlife meat in East and Southern Africa. Nairobi, Kenya: TRAFFIC East/Southern Africa. 264 p. PMID: 25165803
15. NASCO (2013) The state of community conservation in Namibia: A review of communal conservancies, community forests and other CBNRM initiatives (2012 Annual Report). Windhoek, Namibia. 64 p. Available: http://nasco.org.na. Accessed 2014 Mar 11.
16. Ster JC (1973) Safari hunting in the Luangwa valley. Mimeograph. Department of Wildlife, Fisheries and National Parks. Chilanga, Zambia.
17. UN (2011) United Nations 2000 Millennium Declaration. Country development cooperation strategy 2011–2015. Resolution adopted by the General Assembly A/RES/55/2 Fifty-fifth session agenda item 60(b), 18 September 2000. Available: http://www.usaid.gov/zambia. Accessed 2013 Dec 2.
18. von Braun J, Vargas Hill R, Pandya-Lorch R, editors (2009) The poorest and hungry: Assessments, analyses, and actions. IFPRI 2020 Book. Washington, DC: International Food Policy Research Institute. 584 p. Available: http://www.ifpri.org. Accessed 2013 Dec 2.
19. WFP (2010) World Food Programme. Available: http://www.WFP.org. Accessed 2014 Mar 5.
20. FTF (2011) Zambia FY 2011–2015 multi-year strategy. Feed The Future. Available: http://www.feedthefuture.gov. Accessed 2014 Jan 2.
21. GAFSP (2013) Increasing incomes, reducing hunger. Annual Report. Washington, DC: Global Agriculture and Food Security Programme. Available: http://www.GAFSPFUND.ORG. Accessed 2014 Jan 29.
22. FAO (2014) Statistical Yearbook 2014 Africa Food and Agriculture. Report. Accra, Ghana: Food and Agriculture Organization of the United Nations, Regional Office for Africa. Available: http://www.fao.org. Accessed 2014 Nov 30.
23. WB (1986) Poverty and hunger: Issues and options for food security in developing countries. World Bank Policy Study. Washington, DC: World Bank.
24. Henley EC, Taylor JRN, Obukosia SD (2010) The importance of dietary protein in human health: Combating protein deficiency in sub-Saharan Africa through transgenic biofortified sorghum. In: Taylor SL, editors. Advances in food and nutrition research. Burlington, Massachusetts: Academic Press. pp. 21–52. doi: 10.1016/S1043-4526(10)60002-2 PMID: 20691952
25. Bothma JdP, du Toit JG (2010) Game ranch management. Pretoria, South Africa: Van Schaik Publishers. 979 p. PMID: 25506974
26. FAO (2010) Food balance sheets. FAO Statistics Division. Rome, Italy: Food and Agriculture Organization of the United Nations. Available: http://www.fao.org/statistics. Accessed 2014 Mar 6. PMID: 25506974
27. Lewis D (2005) Synergies between animal husbandry and wildlife conservation: perspectives from Zambia. In: Ososky SA, Cleaveland S, Karesh WB, Kock MD, Nyhus PJ, Starr L, Yang A, editors. Conservation and development interventions at the wildlife/livestock interface: Implications for wildlife, livestock and human health. Gland, Switzerland and Cambridge, UK: IUCN. pp. 153–156.
28. Marks SA (2005) Large mammals and a brave people: Subsistence hunters in Zambia. New Brunswick, New Jersey: Transaction Publishers. 285 p. PMID: 25275211
29. ZCSO (2012) Zambia Central Statistical Office. Available: http://www.zamstats.gov.zm. Accessed 2014 Jan 1.
30. Weaver C, Hamunyela E, Diggle R, Matongo G, Pietersen T (2011) The catalytic role and contributions of sustainable wildlife use to the Namibia CBNM programme. In: Abensperg-Traun M, Roe D, O’Crowdain C, editors. CITES and CBNM Proceedings of an international symposium on “The relevance of CBNM to the conservation and sustainable use of CITES-listed species in exporting countries”. Vienna, Austria: IUCN, Gland, Switzerland and IIED, London, UK. pp. 59–70.
31. Shurter S (2013) Gnusletter. IUCN Antelope Specialist Group. doi: 10.1007/s13197-013-0993-z PMID: 25593984
32. Baldus RD (2009) A practical summary of experiences after three decades of community-based wildlife conservation in Africa “What are the lessons learnt?” Budapest, Hungary: Joint Publication of FAO and CIC. 128 p. PMID: 25506961
33. Bennett EL (2002) Is there a link between wild meat and food security? Conservation Biology 16: 590–592.
34. Milner-Gulland EJ, Bennett EL, the SBC 2002 Annual Meeting Wild Meat Group (2003) Wild meat: the bigger picture. Trends in Ecology and Evolution 18: 351–357.
35. Lindsey PA, Balme G, Becker M, Begg C, Bento C, et al. (2013) The bushmeat trade in African savannas: Impacts, drivers, and possible solutions. Biological Conservation 160: 80–96.
36. Nyirenda VR, Liwena S, Kaumba Chaka H (2008) Atlas of the national parks of Zambia. Lusaka, Zambia: New Horizon Printing Press. 47 p. PMID: 25506952
37. Simasiku P, Simwanza H, Tembo G, Mbandopadjhay S, Pavy J (2008) The impact of wildlife management policies on communities and conservation in game management areas in Zambia. Lusaka, Zambia: Natural Resources Consultative Forum. 37 p. PMID: 25506992
38. Skinner JD, Smithers RHN (1990) The mammals of southern African subregion. Pretoria, South Africa: University of Pretoria. 771 p. PMID: 25144095
39. R Development Core Team (2013) R: A language and environment for statistical computing. Vienna, Austria. Available: http://www.Rproject.org. Accessed 2014 Mar 11.
40. Wikipedia (2014) Air travel disruption after the 2010 Eyjafjallajökull eruption. Available: http://en.wikipedia.org/w/index.php?title=2010_Eyjafjallajökull_eruption. Accessed 2014 Mar 18.
41. Damm GR (2008) Recreational trophy hunting: “What do we know and what should we do?” In: Baldus RD, Damm GR, Wollscheid K, editors. Best practices in sustainable hunting—a guide to best practices from around the world. CIC Technical Series Publication No.1. Budapest, Hungary: International Council for Game and Wildlife Conservation. pp. 5–11.
42. Baldus RD, Cauldwell AE (2004) Tourist hunting and its role in development of wildlife management areas in Tanzania. Dar es Salaam, Tanzania: GTZ—Wildlife Programme Tanzania. PMID: 25057686
43. FEWS (2014) Food Security Outlook Update. Available: http://www.fews.net. Accessed 2014 Mar 21.
44. IFAD (2014) International Fund for Agricultural Development. Available: http://ruralpovertyportal.org. Accessed 2014 Nov 30.
45. Ahmed AU, Hill RV, Smith LC, Frankenberger T (2007) The poorest and hungry: characteristics and causes. In: von Braun J, Hill RV, Pandya-Lorch R, editors. Assessments, analyses, and actions: IFPRI 2020 book. Washington, DC: International Food Policy Research Institute. pp. 107–115. Available: http://www.ifpri.org. Accessed 2013 Dec 2.
46. ZVAC (2004) Zambia livelihood map rezoning and baseline profiling. Lusaka, Zambia.
47. ZCSO (2014) The Monthly February 2014. Zambia Central Statistical Office. Available: http://www.zamstats.gov.zm. Accessed 2014 Mar 25. doi: 10.1016/j.fsigen.2014.12.009 PMID: 25596557
48. ZCSO (2014) The Monthly November 2014. Zambia Central Statistical Office. Available: http://www.zamstats.gov.zm. Accessed 2014 Nov 30. doi: 10.1016/j.fsigen.2014.12.009 PMID: 25596557
49. Bennett EL, Blencowe E, Brandon K, Brown D, Burn RW, et al. (2006) Hunting for consensus: Reconciling bushmeat harvest, conservation, and development policy in West and Central Africa. Conservation Biology 21: 884–887.
50. CBD (2011) Incentive measures for the conservation and sustainable use of biological diversity: Case studies and lessons learned. CBD Technical Series No.56. Montreal, Canada: Secretariat of the Convention on Biological Diversity. 65 p. doi: 10.1016/j.recot.2011.11.003 PMID: 23594804
51. Gubbi S (2010) Are conservation funds degrading wildlife habitats? Economic and Political Weekly Vol XLV 26 June 2010, pp. 22–25.
52. Kgosiokoma EO, Mojere M, Harvie BA (2013) Grazing management systems and their effects on savanna ecosystem dynamics: A review. Journal of Ecology and the Natural Environment 5: 88–94.
53. Lindsey PA, Romanach SS, Matena S, Matema C, Mupamhadi I, et al. (2011) Dynamics and underlying causes of illegal bushmeat trade in Zimbabwe. Oryx 45: 84–95.
54. Haller T, Merten S (2008) “We are Zambians: Don’t Tell Us How to Fish!” Institutional Change, Power Relations and Conflicts in the Kafue Flats Fisheries in Zambia. Human Ecology 36: 699–715.
55. IRIN (2014) Zambia: mosquito-net fishing threatens Lake Tanganyika. IRIN Humanitarian news and analysis. Available: http://www.irinnews.org/report/86565. Accessed 2014 Mar 18.
56. Weaver LC, Petersen T (2008) Namibia communal area conservancies. In: Baldus RD, Damm GR, Wollscheid K, editors. Best practices in sustainable hunting—A guide to best practices from around the world. CIC Technical Series Publication No. 1. Budapest, Hungary: International Council for Game and Wildlife Conservation. pp. 48–52.
57. Child BA, Musengezi J, Parent GD, Child GFT (2012) The economics and institutional economics of wildlife on private land in Africa. Pastoralism: Research, Policy and Practice 2:18. Available: http://www.pastoralismjournal.com/content/2/1/18.
58. Oates JF (1999) Myth and reality in the rain forest: How conservation strategies are failing in West Africa. Berkeley, California: University of California Press. 338 p. PMID: 25506965
59. Ahmed J, Bergstrom C, Bryceson I, Child B, Francis J, et al. (2001) Lessons learned: Case studies in sustainable use. International Union for the Conservation of Nature.
60. Brown T, Marks S (2007) Livelihoods, hunting and the game meat trade in northern Zambia. In: Davies G, Brown D, editors. Bushmeat and livelihoods: Wildlife management and poverty reduction. Malden, Massachusetts: Blackwell Publishing Ltd. pp. 92–105.
61. Becker M, McRobb R, Watson F, Droge E, Kanyembo B, et al. (2013) Evaluating wire-snares poaching trends and the impacts of by-catch on elephants and large carnivores. Biological Conservation 158: 26–26.
62. Lewis DM (2007) Can wildlife and agriculture coexist outside of protected areas in Africa? A hopeful model and a case study in Zambia. In: Davies G, Brown D, editors. Bushmeat and livelihoods: Wildlife management and poverty reduction. Malden, Massachusetts: Blackwell Publishing Ltd. pp. 177–196.
63. Davies G, Brown D (2007) Bushmeat and livelihoods: Wildlife management and poverty reduction. Malden, Massachusetts: Blackwell Publishing Ltd. 274 p. doi: 10.1093/jxb/erm028 PMID: 25506957
64. Nasi R, Brown D, Wilkie D, Bennett E, Tutin C, et al. (2008) Conservation and use of wildlife-based resources: The bushmeat crisis. Montreal, Canada and Bogor, Indonesia: Secretariat of the Convention on Biological Diversity and Center for International Forestry Research. 50 p. PMID: 25506952
65. Brashares JS, Golden CD, Weinbaum KZ, Barrett CB, Okello GV (2011) Economic and geographic drivers of wildlife consumption in rural Africa. Proceedings of the National Academy of Sciences 108: 13931–13936. doi: 10.1073/pnas.1011526108 PMID: 21873180
66. FAO (2014) Food and Nutrition in Numbers. Rome, Italy: Food and Agriculture Organization of the United Nations. Available: http://www.fao.org. Accessed 2014 Nov 30. doi: 10.1016/j.jfsigen.2014.12.009 PMID: 25596557

67. Bulletin and Record (2013) The killing fields of Zambia. Special Report. November 2013, Vol. 2. Lusaka, Zambia: Original Publishers Ltd.

68. SLCS (2013) Oct, Nov, Dec Newsletter. South Luangwa Conservation Society. Available: http://www.slcszambia.org.

69. King A (2011) No reason to conserve: Exploring the drivers and performance of wildlife conservation in Kenya. Community-based conservation: Case studies. In: Abensperg-Traun M, Roe D, O'Criodain C, editors. CITES and CBNRM Proceedings of an international symposium on "The relevance of CBNRM to the conservation and sustainable use of CITES-listed species in exporting countries". Vienna, Austria: IUCN, Gland, Switzerland and London, UK. pp. 78–85.

70. ZCSO (2014) Zambia in Figures: 1964–2014. Report. Lusaka, Zambia: Central Statistical Office. Available: http://wwwzamstats.gov.zm. Accessed 2014 Nov 30.

71. OECD (2012) African Economic Outlook. Organisation for Economic Co-operation and Development. Available: http://www.oecd-ilibrary.org. Accessed 2014 Dec 1. doi: 10.1016/j.asjsur.2012.06.010 PMID: 25554668

72. AfricaHunting (2014) Hunting Information by Country. Available: http://www.AfricaHunting.com. Accessed 2014 Dec 1.