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Biological Conservation

The evidence for the bushmeat crisis in African savannas: A systematic quantitative literature review

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ABSTRACT

Bushmeat hunting, trade and consumption is a growing biodiversity and food security concern. Much of the collated research is currently limited to forested regions however, despite indications of the increasing threat in savannas. Savanna regions are biodiverse and often have high-value wildlife tourism industries, but also have rapidly-growing rural populations, often highly dependent on natural resources. In this systematic quantitative literature review we seek to understand the state of knowledge about bushmeat in savanna regions in Africa. We aim to identify gaps in the literature, both spatially and topically, understand what methodologies are used, what common recommendations are made and what interventions have been quantified. We identified 144 relevant studies from the literature. Although studies have increased over time and diversified thematically, there were strong biases. Most studies were conducted in Tanzania, with gaps in research in southern Africa and the Sahelian region. Additionally, only 25% of papers investigated interventions used to reduce bushmeat hunting, with traditional enforcement being the most common intervention studied (53% of intervention studies, 13% of papers). Other frequently recommended interventions such as alternative incomes received little attention (14% of intervention studies, 3.5% of papers). Further, although many studies cite common drivers of bushmeat hunting such as income or livestock, the evidence for these drivers was lacking and contradictory. We reveal that although bushmeat in savanna regions is gaining recognition, many gaps in knowledge remain. This is the first study to systematically quantify the research about bushmeat in African savannas and aims to inform future research.

1. Introduction

Bushmeat hunting is recognised as a major threat to biodiversity in much of the forested regions of the world, especially in West and Central Africa (Fa and Brown, 2009). The term bushmeat is defined here as any non-domesticated terrestrial mammal, bird, reptile or amphibian harvested for food, and can include all steps in the supply chain, including the acquisition, trade and consumption of wild meat (Nasi et al., 2008). Widespread hunting has serious ecological and conservation implications, however the interlinkages between bushmeat and food security in areas with extensive poverty makes this issue particularly challenging to address (Nasi et al., 2011). Bushmeat is both a source of protein and of income to many people (Brown and Williams, 2003), which means animal population collapses due to overhunting are a crisis in terms of both conservation and human development (Fa et al., 2003).

Studies and research into bushmeat hunting has traditionally focussed on tropical forests (Fa et al., 2002), however there is growing recognition that this biodiversity crisis may extend to savanna regions as well (Lindsey et al., 2013a). Formerly viewed as primarily a subsistence activity in rural savanna areas, population growth, systemic poverty and a lack of income-generating activities has drastically increased the reliance on natural resources (Barnett, 1997; Shackleton et al., 2007). Conversely, growing wealth in urban areas has increased the demand for bushmeat (Brashares et al., 2011) which is often priced higher than domestic meat (van Vliet and Mbazza, 2011). Interviews with experts from southern and east African countries indicated that bushmeat is ranked as the top threat to biodiversity in many savanna areas, ahead of threats such as deforestation and habitat fragmentation (Lindsey et al., 2015; Lindsey et al., 2017). Numerous examples exist in savannas of local population collapses due to overhunting (Hayward, 2009; Hofer et al., 2000; Jambiya et al., 2007; Lindsey and Bento, 2012), and the extensive reliance of local communities on bushmeat as a source of protein and income (Boafo et al., 2014; Fischer et al., 2014;

Haule et al., 2002).

The hunting of bushmeat in savanna regions is distinct from forest regions for several reasons. Savannas are more productive than forests in terms of animal biomass (Robinson and Bennett, 2004) and can support profitable formal wildlife-based land uses such as game ranching more easily than forests (Wilkie and Carpenter, 1999b). Many countries in savanna regions rely heavily on wildlife tourism (Okello, 2014) and there is political recognition over the value of wildlife. Livestock is also able to be supported at higher densities, due to both habitat and disease factors (Robinson et al., 2014). Additionally, controlling hunting in savanna regions is both cheaper and more effective than in forests (Jachmann, 2008a). These factors mean that savanna regions may have more leverage points to effectively reduce bushmeat hunting and consumption than forest regions.

Interventions to reduce bushmeat hunting other than traditional enforcement are varied but often revolve around the provision of alternative proteins or income generation (Wicander and Coad, 2014). Many of these projects are however limited by small scope, short time frames and underfunding. Community-based Natural Resource Management (CBNRM) has been encouraged in order to meet both conservation and community development goals, but monitoring of success is often limited (Brooks et al., 2013). Other problems with this approach include elite capture, failure to secure long-term funding and failure to build local capacity and institutions (Balint, 2006; Brooks et al., 2013; Webber et al., 2007). Although many countries in Africa have embraced the use of community-based conservation (Roe et al., 2009), traditional enforcement techniques such as ranger patrols remain a top priority for many protected areas and have been found to be effective at reducing bushmeat poaching (Jachmann, 2008b). The use of such enforcement to reduce bushmeat can be controversial however, given the increasingly militarized nature of such techniques (Duffy, 2014). Also, in protected areas a priority to combat high-value hunting for elephants and rhinos may overshadow conservation involving noncharismatic animals (Challender and MacMillan, 2014; Sitas et al., 2009), such as those involved in bushmeat poaching.

The drivers of bushmeat hunting and consumption vary substantially in the published literature. On large scales, increasing demand due to growing human populations, poverty and food insecurity and a lack of clear community ownership of wildlife have been identified as key drivers (Lindsey et al., 2013a). However, more specific drivers are often contradictory in nature and depend strongly on the context of study. The relationship between bushmeat and income or wealth may not be straightforward for example. Although poverty is often considered a key driver of hunting (Knapp et al., 2017), wealthier households sometimes hunt more than poorer households, but may be wealthier *due* to hunting rather than hunting *because* they are wealthy (Nielsen et al., 2014; Travers et al., 2017). Complicated relationships between basic drivers and bushmeat hunting or consumption are a key challenge to address when planning interventions.

The knowledge regarding bushmeat hunting in forest biomes have been reviewed numerous times (Abernethy et al., 2013; Fa et al., 2002; Fa and Brown, 2009; Petrozzi et al., 2016; van Vliet and Mbazza, 2011; Wilkie and Carpenter, 1999a) and efforts to create databases of research in this biome are already underway (OFFTAKE: global in scope, majority of data from central and West Africa; SYVBAC: Central African bushmeat monitoring system). This is not the case for bushmeat hunting in savannas, where research is largely uncollated. Reviews on the topic are narrative in nature and limited to Barnett (1997), Lindsey et al. (2013a) and Lindsey et al. (2015 FAO report), all of which stress the urgent need for more research to be conducted in the savanna biome. Understanding the gaps in knowledge and visualising some of the known trends on this topic could facilitate more effective research in the future, and establishing an evidence base is a key goal to enable effective conservation (Sutherland et al., 2004). We therefore conducted a quantitative systematic literature review in order to answer the following question: what is the state of knowledge about bushmeat

hunting in savanna regions of Africa and where are the gaps in knowledge, spatially and topically? We also sought to answer the following questions:

- Was there agreement in relation to the drivers thought to be responsible for hunting and consumption of bushmeat in the savanna system, and how did these compare to forests?
- What were the common methodologies used to study bushmeat in savannas, and how did these compare to methods used in forest regions?
- What evidence of effectiveness of interventions was currently available?
- What were the prevailing policy recommendations from the literature?

We discuss the current gaps in research and highlight specific areas which require more research attention in future. We also discuss some of the key limitations to bushmeat research in savanna regions and how these limitations might be addressed.

2. Methods

2.1. Search strategy

Quantitative systematic reviews allow a structured and comprehensive collation of information and research that is currently available (Pullin and Stewart, 2006). This methodology included four stages: "planning", which included the formulation of the topic, review protocol and keywords, "searching" which included selection of relevant data and assessment of publications, "data extraction" where the studies were entered into a structured database and "data synthesis", which included both qualitative and quantitative analysis (Pickering and Byrne, 2014; Pullin and Stewart, 2006).

Searches were performed in ISI Web of Science and SCOPUS from March 2017 to July 2017. The search terms used were "bushmeat", "illegal hunting", poach*, "wild meat", "wildlife harvest*" and "non-timber forest products", which were separated by the OR operator. "Africa" was included with these terms in this search, using the AND operator. A second search was conducted at the same time, but the name of a country e.g. "Zimbabwe" was used instead of "Africa". Thirty-five different country names were searched, representing countries which included savanna habitat (List available in Supplementary Table 2). To find countries with areas of savanna habitat, the biomes of Olson et al. (2001) were used, specifically the biome "tropical and subtropical grasslands, savannas and shrublands" and including Xeric savannas. The GIS layer associated with this publication (available at https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world) allowed the identification of all countries which included this biome within their borders. Original articles, reviews and proceedings papers were included in the search. "Grey literature" such as reports and policy statements were excluded. No time frame limit was used. If an article was only available in a non-English language the article was translated by a native speaker of that language. The searches included titles, abstracts and keywords. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting of search results (Moher et al., 2009). These guidelines encourage reporting of a minimum set of items in systematic reviews. An examination of the reference lists in key bushmeat review papers (n = 9) was also completed to ensure that all relevant studies had been identified.

2.2. Exclusion criteria

All papers found in the online database searches were then screened for relevance, using abstracts and titles. A second round of screening involved reading the paper in full, following which papers were either