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SHORT COMMUNICATION

Legal subsistence hunting trends in the Ugalla ecosystem of western Tanzania

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Abstract Sustainable legal subsistence hunting has a place in conservation. Nonetheless, the long-term success of such schemes depends on them being well managed. We assessed the effectiveness of legal subsistence hunting in the Ugalla ecosystem of western Tanzania using data from the local legal hunting scheme. The hunting in the ecosystem is conducted within the partially protected areas around Ugalla Game Reserve. The Wildlife Division of Tanzania supervises hunting activities in the area via local conservation authorities. We analysed hunting success (animals shot per quota per licence) across species in the period from 1997 to 2004. Our results revealed that 10,511 and 5,991 animals were licenced and shot, respectively. There were considerable variations in hunting success across wildlife species. With the exception of common duiker (*Sylvicapra grimmia*), hunting success trends for most of the species were declining. The documented decline in wildlife off-take should be further investigated to ensure the sustainable management of this area.

Keywords Western Tanzania · Ugalla ecosystem · Partially protected areas · Legal subsistence hunting · Hunting success

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Introduction

Well-managed legal subsistence bushmeat hunting is an important conservation tool in two ways as follows: first, it acts as a sustainable means of meeting protein demands of people (Milner-Gulland and Rowcliffe 2007); and second, it occurs in areas outside or adjacent to core wildlife protected areas (buffer zones) (Msoffe et al. 2007).

Legal subsistence hunting in Tanzania takes place in game-controlled areas and open areas (hereinafter collectively referred to as partially protected areas) (Mabugu and Mugoya 2001). Most of these adjoin core-protected areas such as game reserves and national parks (Shauri and Hitchcook 1999). The hunting scheme is administered by the Wildlife Division of Tanzania and district game offices (Mabugu and Mugoya 2001). District game officers apply for hunting quotas to the Wildlife Division, and then issue hunting licences to local people (Mabugu and Mugoya 2001).

Owing to poor supervision and abuse of hunting quotas, the sustainability of the subsistence hunting is generally uncertain (Baldus and Cauldwell 2004). The present study is aimed at communicating the efficiency of the licenced resident hunting in the partially protected areas adjacent to Ugalla Game Reserve in western Tanzania by examining how hunting success trends (number shot as a proportion of individual animals that were licenced per hunter) differ across species.

Methods

Study area

Ugalla Game Reserve lies between longitude 31°26′ to 32°23′ E and latitude 5°31′ to 6°03′S, covering an area of approximately 5,000 km^2 in the western part of Tanzania (Fig. 1).

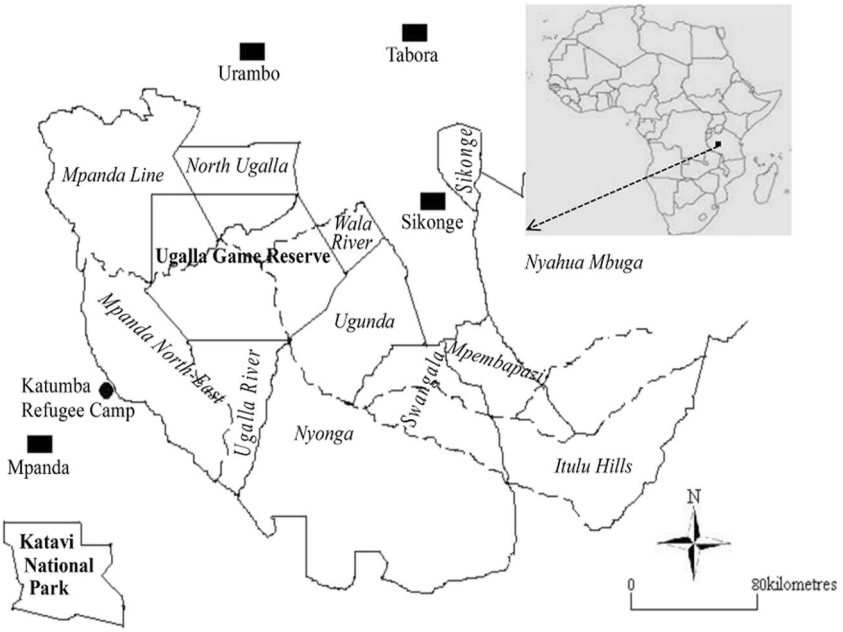

Fig. 1 Forest reserves (partially protected areas) around Ugalla Game Reserve, where legal subsistence bushmeat hunting takes place. *Filled rectangles* show approximate locations of the administrative districts around the game reserve. Katavi National Park and Katumba refugee camp are also shown. *Broken lines* represent different rivers traversing the ecosystem

Four administrative districts (Urambo, Tabora, Sikonge and Mpanda) are located close to the reserve. The reserve constitutes a critical component of the Ugalla ecosystem (Ugalla Game Reserve 2006). It borders several forest reserves, in which licenced resident hunting takes place. Ugalla Game Reserve is known as the only source of animals for the adjacent partially protected areas and forest reserves (Hazelhurst and Milner 2007).

Subsistence hunting

The local management of the legal subsistence hunting in the Ugalla ecosystem is conducted by the district game offices in Sikonge, Urambo, Tabora and Mpanda districts. The information on subsistence hunting comes from 1997 to 2004; years outside this period had insufficient data. Hunting is legally allowed between 1st July

Table 1 Numbers of different species shot against licenced (quota) over the study period, 1997—2004, through legal subsistence hunting in the Ugalla ecosystem, western Tanzania. Species and their respective biomass are also presented

Species	Local name	Biomass (kg)	Quota	Shot
Buffalo (*Syncerus caffer*) Sparrman, 1779	Nyati	450	385	201
Eland (*Taurotragus oryx*) Pallas, 1766	Pofu	340	107	24
Kongoni (*Alcelaphus buselaphus cokii*) Günther, 1884	Kongoni	125	999	618
Topi (*Damaliscus korrigum*) Ogilby, 1837	Nyamera	100	729	438
Bushpig (*Potamochoerus porcus*) Linnaeus, 1758	Nguruwe	54	54	24
Warthog (*Phacochoerus aethiopicus*) Pallas, 1766	Ngiri	45	481	290
Impala (*Aepyceros melampus*) Lichtenstein, 1812	Swalapala	40	952	588
Reedbuck (*Redunca redunca*) Pallas, 1767	Tohe	40	1,118	557
Bushbuck (*Tragelaphus scriptus*) Pallas, 1766	Pongo	30	270	134
Common Duiker (*Sylvicapra grimmia*) Linnaeus, 1758	Nsya	15	1,241	780
Oribi (*Ourebia ourebi*) Zimmermann, 1782	Taya	14	642	352
Dik-dik (*Madoqua kirkii*) Ogilby, 1837	Digidigi	5	945	549
Suni (*Nesotragus moschatus*) Von Dueben, 1846	Paa	4.5	257	149
African hare (*Lepus capensis*) Linnaeus, 1758	Sungura	2	77	71
Ducks & gees (*Anatidae*) Vigors, 1825	Mabata	1	672	385
Helmeted guineafowl (*Numida meleagris*) Linnaeus, 1758	Kanga	1	1,087	541
Francolins (*Francolinus*) Stephens, 1819	Kwale	0.5	495	290

Species are listed in descending body mass

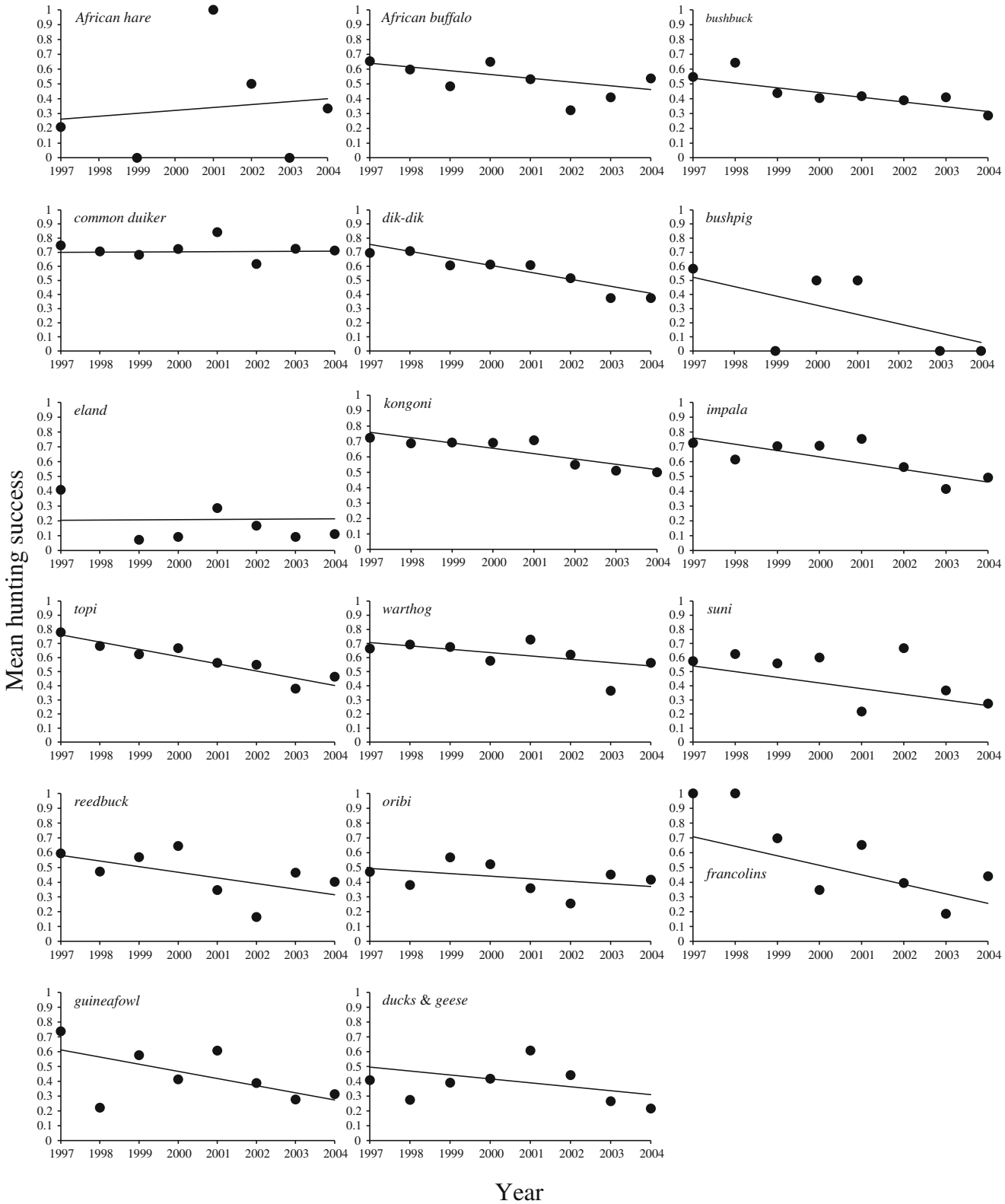

Fig. 2 Time (years) plotted against hunting success rate for different species removed through legal subsistence bushmeat hunting in the Ugalla ecosystem. *Trend lines* were fitted using estimates (effects) generated by the GLMM model

and 31st December each year (dry season). During this time, hunting licences are issued allowing hunters to hunt a specified number of individuals of each wildlife species for 14 consecutive days.

Hunters are allocated to hunting sites (see Fig. 1) in a haphazard manner. Upon completion of a hunting episode, animals shot are reported to the district game officers. We obtained detailed and consistent hunting information from Sikonge and Urambo districts, which included animals licenced (quota) and shot per species per year per licence.

Statistical analysis

All analyses were conducted in GenStat (release 10, VSN International Ltd., Hemel Hempstead, UK). Hunting success trends were analysed with a generalised linear mixed model (GLMM), where the response variable "hunting success" was modelled with a binomial error structure and a logit link function. The hunter's licence number (normally shown on the top of the hunting licence) was included in the model as a random effect. The predictors were district (fixed factor), species (fixed factor), year (covariate) and relevant interactions. Here, the statistical significance of fixed effects was assessed by Wald F tests. The significance level for all statistical tests was set at 5 %.

Results

Seventeen species were removed through legal bushmeat hunting in the Ugalla ecosystem from 1997 to 2004 (Table 1 and Fig. 2), with pooled total individuals 10,511 and 5,991 licenced and shot, respectively (Table 1).

Table 2 presents results of the GLMM for hunting success. All predictors in the model except district × species × year significantly influenced hunting success. Individual hunters in Urambo were more likely to shoot animals they had paid for than those in Sikonge. Overall, hunting success tended to decrease with time (slope (mean±s.e., −0.099±0.05), $n=8$ years), more so in Sikonge (−0.13±0.051) than Urambo (−0.021±0.032).

Table 2 Results from the GLMM of the legal subsistence hunting in the Ugalla ecosystem. The response variable, hunting success (animals shot quota^{-1} licence^{-1}), was modelled with a binomial distribution and a logit link function

	n.d.f., d.d.f	F statistic	Probability
Year	1,1339	106.71	<0.001
District	1,2249	56.78	<0.001
Species	16,4903	17.25	<0.001
District × Year	1,2569	11.62	<0.001
District × Species	15,4931	2.08	0.008
Species × Year	16,4910	1.93	0.014
District × Species × Year	15,4916	1.23	0.238

Variance component for the random factor (hunter's licence number): 0.195±0.038

Hunting success varied significantly across species between the two districts. With the exception of African hare and bushpig, success rates for all species were higher in Urambo than Sikonge. Trends in hunting success also differed significantly between species (Fig. 2). For most of the ungulates, success rate decreased with time. Of the gamebirds, francolins and guineafowl had similarly decreasing trends of hunting success rate.

Discussion

The results suggest that legal subsistence bushmeat hunting in the partially protected areas of the Ugalla ecosystem may not be effective, as widely acknowledged elsewhere (e.g. Baldus 2001; Newmark 2008; Wittemyer et al. 2008; Abensperg-Traun 2009). Hunting success decreased with time, we found decreasing trends in hunting success in all mammal species except common duiker and African hare.

Notwithstanding the fact that it is commonly preferred for bushmeat (Lwanga 2006), common duiker can endure anthropogenic habitat disturbances; thus, they are predictably abundant outside protected areas (Averbeck et al. 2009). Carpaneto and Fusari (2000) found that common duiker had the largest number of individuals removed by local hunters in the Ugalla ecosystem. Hunting success patterns for African hare and bushpig may have been influenced by the availability of data as, unlike other species, these had information for 6 out of 8 years of data. Bushbuck, dik-dik, kongoni, topi and warthog showed a consistently declining pattern, which is informative considering their exploitation pressures at similar sites in Tanzania (Carpaneto and Fusari 2000; Stoner et al. 2007; Waltert et al. 2009).

Eland had a surprisingly low success rate throughout (consistently less than 40 %), which is possibly due to overexploitation outside Ugalla Game Reserve. A study in the Katavi–Rukwa ecosystem in western Tanzania (with habitats similar to Ugalla) found overexploitation of eland in hunted areas (Waltert et al. 2009). Likewise, some of the species are known to be under continuous pressure from both legal and illegal hunters in other conservation areas. For example, impala in Serengeti (Setsaas et al. 2007) and Zimbabwe (Lindsey et al. 2011), buffalo in Uganda (Olupot et al. 2009), reedbuck, oribi and warthog in central Mozambique (Lindsey and Bento 2012).

Hunting success rates for gamebirds declined sharply from 2001 to 2004. This cannot straightforwardly be related to overexploitation as in the case of mammal species. In other hunted areas in the Serengeti ecosystem, exploitation does not affect gamebirds (Magige et al. 2009) in the same way it affects mammals (see Makacha et al. 1982; Setsaas et al. 2007). Nevertheless, the presence of gamebirds on hunting quotas shows their potential conservation value in partially protected areas. The Ugalla ecosystem is rich in gamebird

species (Ugalla Game Reserve 2006), and if bird hunting could be sustainably promoted, it could be of both economic and conservation importance, just like duck hunting in southern Australia (Bennett and Whitten 2003).

Possible causes of drops in hunting success rates of most of the hunted species include loss of animals resulting from poorly managed legal subsistence hunting scheme, poaching (Ugalla Game Reserve 2006) and habitat destruction (Hazelhurst and Milner 2007). Habitat destruction in Ugalla is largely an outcome of poor agricultural practises such as encroachment into hunting areas through extensive cultivation of tobacco (Kikoti 2009; Wilfred and MacColl 2010). Tobacco production involves slash-and-burn to ensure the availability of enough land for an increased profit (Mangora 2005), and the removal of substantial amounts of wood for curing tobacco leaves (Geist et al. 2009) at the expense of wildlife habitats. Furthermore, extensive livestock grazing and expanding human settlements alter the vegetation and consume a large proportion of the habitat (United Republic of Tanzania 1998).

Poaching of small, medium and large mammals in the area cannot be overstated (Carpaneto and Fusari 2000; Wilfred and MacColl 2010). Poaching is intensified by poverty, bushmeat trade and a massive increase in demand for animal protein. Refugees from the nearby Katumba camps are the most problematic poachers (Ugalla Game Reserve 2006). The Tanzania Wildlife Division has established an anti-poaching unit in western Tanzania responsible for controlling the problem particularly in partially protected areas and overseeing legal subsistence hunting activities in collaboration with village game scouts. But with limited staff, budget and other resources, the unit appears to have been overstretched (Wildlife Division 1998; Ugalla Game Reserve 2006). In Serengeti, Holmern et al. (2007) observed that inadequate resources crippled anti-poaching efforts in partially protected areas. In the same vein, we cannot rule out the possibility that some local hunters in our study area might have reported lower numbers of the animals they actually killed as a result of inefficient anti-poaching efforts. However, during hunting seasons, most of the hunting episodes were followed by village game scouts or rangers as a strategy for ensuring adherence to hunting quotas (Mr. K. Twaha, District Game Officer in Sikonge, pers. comm.). In fact, further research is needed to understand the nature and impact of wildlife law enforcement in subsistence hunting and the ensuing conservation implications.

In general, we suspect that—like Ugalla—legal local hunting schemes in partially protected areas (buffer zones) elsewhere in the country are not compatible with conservation aspirations, and immediate measures may need to be undertaken to reverse contracting wildlife populations. Active supervision coupled with effective law enforcement, livelihoods improvement and raising conservation awareness through outreach programmes are necessary to minimise hunting impacts in buffer zones as overexploitation in these areas may be destructive to core-protected areas (Mwalyosi 1991; Shauri and Hitchcook 1999).

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