

Complementary benefits of tourism and hunting to communal conservancies in Namibia

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Abstract: *Tourism and hunting both generate substantial revenues for communities and private operators in Africa, but few studies have quantitatively examined the trade-offs and synergies that may result from these two activities. We evaluated financial and in-kind benefit streams from tourism and hunting on 77 communal conservancies in Namibia from 1998 to 2013, where community-based wildlife conservation has been promoted as a land-use that complements traditional subsistence agriculture. We used data collected annually for all communal conservancies to characterize whether benefits were derived from hunting or tourism. We classified these benefits into 3 broad classes and examined how benefits flowed to stakeholders within communities under the status quo and under a simulated ban on hunting. Across all conservancies, total benefits from hunting and tourism increased at roughly the same rate, although conservancies typically started generating benefits from hunting within 3 years of formation as opposed to after 6 years for tourism. Disaggregation of data revealed that the main benefits from hunting were income for conservancy management and food in the form of meat for the community at large. The majority of tourism benefits were salaried jobs at lodges. A simulated ban on trophy hunting significantly reduced the number of conservancies that could cover their operating costs, whereas eliminating income from tourism did not have as severe an effect. Given that the benefits generated from hunting and tourism typically begin at different times in a conservancy's life-span (earlier vs. later, respectively) and flow to different segments of local communities, these 2 activities together may provide the greatest incentives for conservation on communal lands in Namibia. A singular focus on either hunting or tourism would reduce the value of wildlife as a competitive land-use option and have grave repercussions for the viability of community-based conservation efforts in Namibia, and possibly other parts of Africa.*

Keywords: communal lands, community-based conservation, financial benefits, hunting ban, in-kind benefits, stakeholders

Resumen: *El turismo y la caza generan ingresos públicos sustanciales para las comunidades y los operadores privados en África, pero pocos estudios han examinado cuantitativamente las compensaciones y las sinergias que pueden resultar de estas dos actividades. Evaluamos las oleadas de beneficios financieros y de pago en especie provenientes del turismo y la caza en 77 zonas de conservación comunal en Namibia desde 1998 a 2013, donde la conservación de vida silvestre basada en la comunidad ha sido promovida como un uso de suelo que complementa la agricultura tradicional de subsistencia. Usamos datos colectados anualmente de todas las zonas comunales para caracterizar si los beneficios se derivaron de la caza o el turismo. Clasificamos estos beneficios en tres categorías generales y examinamos cómo los beneficios fluyeron hacia los accionistas dentro de las comunidades bajo el status quo y bajo una prohibición simulada de la caza. En todas las zonas de conservación comunal, los beneficios totales de la caza y el turismo incrementaron aproximadamente a la misma tasa, aunque en estas zonas se comenzaron a generar beneficios de la caza normalmente dentro de los 3 años de formación, en contraste con del turismo que se generaron después de 6 años. La desagregación de los datos reveló que los principales beneficios de la caza fueron los ingresos para*

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el manejo de la conservación y la comida en forma de carne para la mayoría de la comunidad. La mayoría de los beneficios del turismo fueron trabajos a sueldo en hospedajes. Una prohibición simulada sobre la caza de trofeos redujo significativamente el número de zonas de conservación que podrían cubrir sus gastos de operación, mientras que la eliminación del ingreso por el turismo no tuvo un efecto severo. Dado que los beneficios generados por la caza y el turismo comienzan comúnmente a tiempos distintos en la duración total de la conservación (más temprano que más tarde, respectivamente) y fluyen a segmentos diferentes de las comunidades locales, estas dos actividades juntas pueden proporcionar incentivos más grandes para la conservación en las tierras comunales de Namibia. Un foco único sobre la caza o el turismo puede reducir el valor de la vida silvestre como opción de uso de suelo competitivo y tener repercusiones graves sobre la viabilidad de los esfuerzos de conservación basada en comunidades de Namibia, y posiblemente de otras partes de África.

Palabras Clave: accionistas, beneficios financieros, beneficios de pago en especie, conservación basada en la comunidad, prohibición de la caza, tierras comunales

Introduction

Current paradigms in conservation increasingly emphasize the utilitarian aspect of safeguarding biodiversity (Daily et al. 2009; Redford & Adams 2009; Guerry et al. 2015), as opposed to more traditional strategies such as protected areas and strict land-use zoning. Ecosystem service approaches and payments for environmental services (PES) schemes are based on the assumption that ensuring a supply of environmental benefits to people will result in the conservation of biodiversity and of natural areas (Tallis et al. 2009; Tallis & Polasky 2009). However, this increasing emphasis on a utilitarian approach to conservation has spawned much debate and criticism. Some contend this new conservation diverts efforts away from ensuring the persistence of biodiversity and puts too much focus on human needs and well-being (Soule 2013; Doak et al. 2014). Others argue that PES programs and partnerships with corporations are resulting in the commodification of nature and that market-based approaches are likely to favor the rich, powerful, and foreign at the expense of local communities and the poor (Sullivan 2006; Igoe et al. 2010).

Although approaches to natural resource management and biodiversity conservation in southern Africa have long been grounded in similar utilitarian perspectives (Child 2004; Carruthers 2008), few approaches to conservation are currently as controversial as the hunting of large and charismatic species as a means of generating benefits and incentives for conservation in this part of the world (Lindsey et al. 2006; Lindsey et al. 2007). Heightened concerns surrounding animal rights and the ethics of hunting, often inflamed by images on social media of trophy hunters posing with dead animals, have led to an increasingly vocal Western opposition to trophy hunting in Africa. This opposition is contributing to tangible policy changes, including the banning of trophy hunting in Botswana (Pabst 2013), restrictions on imports of trophies of certain species to countries such as the United States and Australia (Milman 2015), and the barring of trophies from being transported on some major com-

mercial airlines (Wieczner 2015). Ironically, this Western opposition to trophy hunting comes despite the fact that hunting benefits were one of the early motivations for conservation in North America (Geist et al. 2001), and even today proceeds from hunting licenses in the United States (via the Pittman-Robertson Act) and Canada continue to generate hundreds of millions of dollars every year for wildlife management and habitat protection (Arnett & Southwick 2015).

The impact that changes in hunting policies may have on the conservation of wildlife and on the incentives for African people to coexist with wildlife is not well understood (Buckley & Mossaz 2015). There has been little examination of how benefits from hunting compare with benefits from nonconsumptive nature-based tourism in terms of incentives for local people to conserve species and wildlife habitat, although others have suggested the two may be complementary, rather than substitutive, activities (Leader-Williams et al. 2001; Lindsey et al. 2006). A major limitation is that data on the variety of financial benefits that wildlife generate are typically not systematically collected, especially across different temporal and spatial scales. Yet understanding who benefits, and how, from wildlife as a land use is a critical prerequisite to designing effective policies and programs that support conservation as a sustainable alternative to other, less biodiversity friendly, land uses.

Despite the above knowledge gaps, it is clear that for wildlife to survive outside (and perhaps even inside) protected areas in Africa, people must have strong incentives to tolerate, or ideally embrace, wildlife as a land use (Roe et al. 2009; Dickman et al. 2011; Child et al. 2012). Given that strict protected areas comprise a small and unrepresentative fraction of the African continent, and that even within protected areas wildlife is declining (Western et al. 2009; Craigie et al. 2010), approaches that seek to capture multiple benefits from wildlife conservation on state, private, and communal lands in Africa are indispensable. This principle is especially important when considering the diverse relationships between local communities and wildlife. Communities living with wildlife

are not monolithic entities; rather, they are composed of different groups of people who will experience different costs and benefits from wildlife conservation (Agrawal & Gibson 1999; Roe et al. 2009). For example, wealthy cattle owners and poor subsistence farmers will have different perceptions of wildlife conservation given the particular costs and benefits they are likely to experience. Diversifying benefit streams from wildlife conservation so that the variety of stakeholders within local communities are incentivized to promote or at minimum tolerate living with wildlife will provide the greatest likelihood that conservation as a land use will ultimately prove more attractive than wildlife-unfriendly alternatives. Because communal lands comprise a large fraction of rural Africa (up to 500% more than state-managed forest reserves and national parks [Alden Wily 2011]), management of these lands will play a huge role in determining the success or failure of biodiversity conservation efforts across the continent.

We focused on how different types of benefits provided by wildlife vary over time, space, and community stakeholder groups in communal conservancies in Namibia. Namibia's Community-Based Natural Resource Management (CBNRM) program began in the mid-1990s, when progressive legislation for the devolution of conditional rights to natural resources allowed communities to register areas of customary landholding as "communal conservancies." Registering these conservancies (involving developing zoning and sustainable resource management plans and a constitution) allows local communities to manage and benefit from wildlife and other natural resources on their traditional lands. Prior to the legislation, natural resources were the sole property of the state. Although wildlife has been used by people for millennia in the region that is now Namibia, the last century was characterized by declines in various species, starting with the rinderpest outbreak at the end of the 19th century, followed by overhunting of big game species by colonial hunters, and more recently by a major drought combined with a poaching increase in the 1980s (Owen-Smith 2010). Namibia's CBNRM program is widely recognized as having contributed to a strong recovery of wildlife in large parts of the country, through the creation of social and economic incentives for the sustainable coexistence of wildlife and people on communal lands (Owen-Smith 2010; Naidoo et al. 2011b; NACSO 2013). Additionally, the principles used to incentivize communities to steward wildlife across very large spatial scales are already being adopted by numerous other countries in Africa and beyond (NACSO 2013). We examined how changes in benefits over time generated on communal conservancies in Namibia vary according to whether they were derived from tourism or hunting (the 2 most significant benefits derived from wildlife). We also assessed how these benefits flow to different stakeholders within local communities and how factors such as time of establishment

and changes in resource management policies affect such benefit flows on communal lands.

Methods

We used data from 77 communal conservancies registered by 2012 in Namibia to examine benefit flows associated with hunting and photographic tourism. The first four of these conservancies were established in 1998, and we used data through the 2013 calendar year for all of them. For both hunting and tourism, conservancies negotiate agreements with private operators. The agreements between conservancies and operators specify the portion of income the conservancy receives (typically 8–12% of total lodge revenue and from 30–75% of trophy price, depending on the species) and jobs to be offered to community members with the operation (from 20–50 for tourism lodges, depending on factors such as size and location, and 8–10 for hunting camps). In addition, community members hunt for subsistence and allow local sales of meat from wildlife through game cropping. Information on fees paid to conservancy management committees; salaries of community members employed in the tourism or hunting industry; and nonfinancial benefits (primarily meat from hunting, but also meals, training, human-wildlife conflict compensation, and other donations to the community at large) is compiled annually by every conservancy. Financial reporting of conservancies is supported by various nongovernmental organizations, is ground-truthed, and is double-checked against analogous reports from tourism and hunting operators.

We used these data and categorized each source of benefit as to whether it was derived from tourism or from hunting. The CBNRM program uses the price of buying alternative meat as the value of wild meat distributed from animals that were hunted (replacement-cost shadow price approach). In 2013, it was 18 Namibian dollars/kg of meat (NACSO 2013). This shadow price can vary and is adjusted from year to year to reflect supply and demand, but the same rate is applied across the country in order to maintain comparability of meat benefits generated in different regions. We used a consumer price index produced by the Bank of Namibia to standardize benefit figures from all years into constant 2013 Namibian dollars. We subsequently expressed all figures in 2013 U.S. dollars (U.S.\$) based on the average monthly exchange rate in 2013 of U.S.\$1 = N\$9.64.

We divided benefits into the 3 classes (described above) because each represented a different type of gain that is channeled to different parts of a conservancy and has different implications for the sustainability of the conservancy and for its livelihood value to members. Income (i.e., fees from lodge and hunting concessions) to management committees is used by conservancies to cover operational and management costs

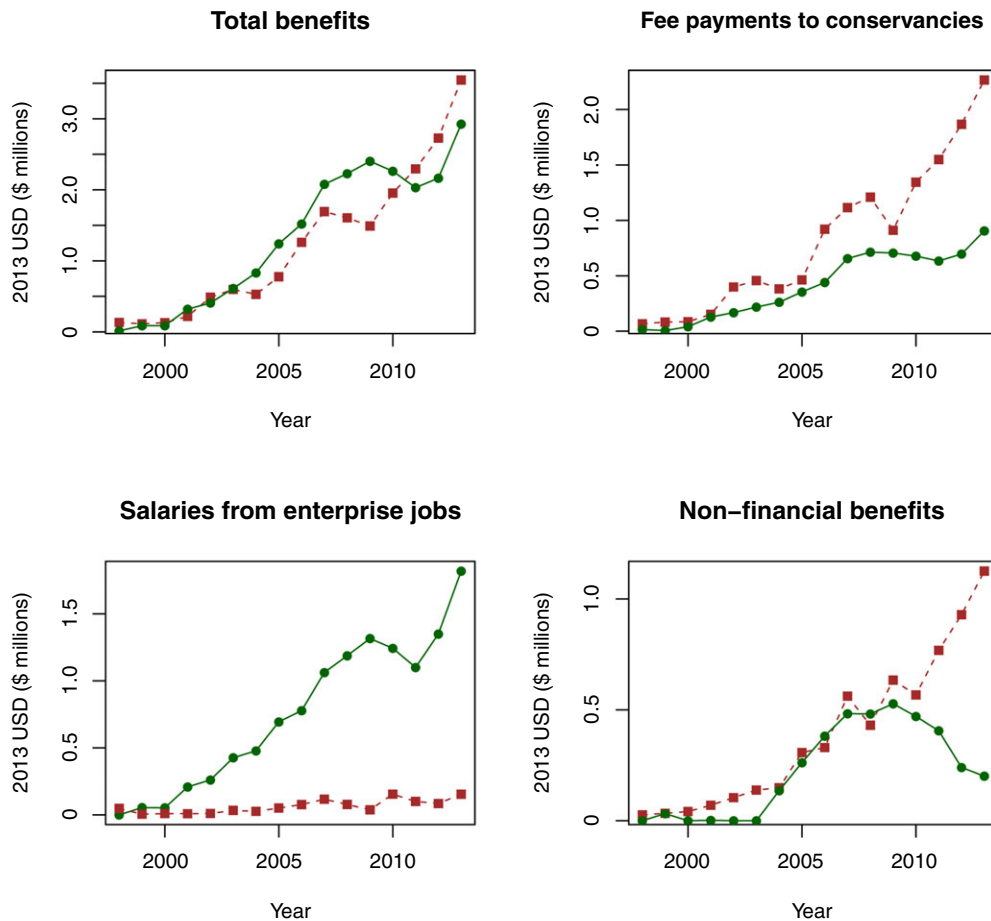


Figure 1. Benefits generated across all conservancies in Namibia's Community-Based Natural Resource Management program, 1998–2013, from hunting (squares) and tourism (circles): (a) total benefits, (b) fee payments to conservancies, (c) salaries from enterprise jobs, and (d) nonfinancial benefits.

(including paying the salaries of community game guards and other conservancy staff members, vehicle fuel costs and maintenance, and office upkeep expenses) and is also distributed as cash and funds for development projects within the community. Individual conservancy members who are salaried employees at tourism lodges or hunting camps clearly benefit financially from conservation, and this linkage should result in strong incentives for promoting wildlife as a land use in their households and among their families and social networks within the community. Conservancy members also benefit individually from the consumption of wild meat that is distributed throughout the community from hunted animals. This benefit, although nonfinancial, is typically viewed as a strong and very direct link between the value of having wildlife on communal lands and the members' livelihoods and well-being (NACSO 2013). To quantify the magnitude of these financial flows from hunting and tourism to stakeholders within communities, we used a subset of conservancy data from 2011 to 2013, during which time detailed financial accounting statements were used to track incoming conservancy revenue.

To simulate how a trophy hunting ban would affect the viability of communal conservancies in Namibia, we used detailed financial statements that were available for a subset of 50 conservancies in 2013 (all but two of the 52 conservancies that generated some level of benefits in 2013) and tabulated the operating costs each conservancy accrued. We then simulated the effects of a ban by removing all cash income that conservancies earned from trophy hunting in 2013 (assuming this cash income could not be substituted by increases in tourism) and calculated the difference in the proportion of conservancies that were able to cover their operating costs based on conservancy income under the status quo versus under a trophy-hunting ban. For comparison's sake, we removed all conservancy income from tourism and assessed how this changed financial viability of conservancies. We also used data on harvested animals and nationally averaged trophy prices to estimate the contribution of individual wildlife species to trophy hunting income.

Finally, for each conservancy we split total benefits over time into 2 series, one for hunting and one for tourism (Supporting Information). We characterized

these financial time series by calculating 4 metrics per conservancy: temporal trend (slope from a linear regression of benefits on year); volatility (root mean square error from the linear regression); end point (magnitude of benefits in 2013); and lag time between year conservancy registered and year the first benefits were generated.

We used *t* tests on these metrics to assess whether temporal flows of benefits to conservancies were significantly different between hunting and tourism.

Results

Of the 77 conservancies established by 2012, 25 reported not generating any benefits from either hunting or tourism. Considering all conservancies in Namibia's CB-NRM program, aggregate benefits increased over time (Fig. 1). Total benefits from tourism and hunting were similar in the early years of the program, but tourism benefits exceeded those from hunting from 2003 to 2010, whereas from 2011 to 2013 the benefits from hunting were greater than tourism benefits (Fig. 1a). Although fee payments to conservancies and nonfinancial benefits (primarily meat) from hunting accumulated at higher levels than those from tourism (Figs. 1b and d), total salaries from tourism enterprise jobs increased 10 times faster than salaries from hunting jobs (Fig. 1c). Nonfinancial benefits from tourism dropped sharply from 2011–2013 relative to continued increasing nonfinancial benefits from hunting (Fig. 1d), a result that may have coincided with the worldwide economic downturn in 2008 and fewer available resources for tourism companies to make additional contributions to conservancies.

Conservancies were formed in roughly 4 cohorts that coincided with (1) initial heavy donor investment (1998–2001, 15 conservancies), (2) a period of declining donor investment (2003–2005, 29 conservancies), (3) an upturn in investment peaking in 2009 (2006–2009, 15 conservancies), and (4) a further increased-investment phase (2011–2013, including 18 conservancies registered by the end of 2012). The earliest conservancies, in cohort 1, had similar levels of total benefits for the first 6 years after registration, after which benefits from both hunting and tourism continued to increase but at a faster rate for tourism (Fig. 2a). Conservancies in cohort 2 (Fig. 2b) had roughly similar rates of growth in total benefits from tourism and hunting, whereas cohorts 3 (Fig. 2c) and 4 (Fig. 2d) earned virtually no benefits from tourism and had either moderate (cohort 3) or low (cohort 4) benefits from hunting.

Disaggregating the national-level data revealed that pathways for generating benefits over time varied substantially among conservancies (Supporting Information). Of the 52 conservancies that derived some level of benefits from wildlife, 28 derived all or almost all of their total benefits from hunting, 6 derived all or almost

all benefits from tourism, and 18 had substantial levels of benefits from both hunting and tourism.

Although there was a tendency for the total benefits from tourism to be higher than those from hunting, there were no significant differences for any of the conservancy time series metrics (Table 1). The only exception to this was the lag time between conservation formation and the beginning of benefits generation. After their formation, conservancies derived benefits from hunting approximately twice as quickly as they derived benefits from tourism (Table 1). On average, conservancies started generating benefits from hunting about 3 years after their formation, whereas it took 6 years, on average, after conservancy formation to start generating benefits from tourism.

In addition to temporal and spatial differentiation, there were differences in how benefits from tourism and trophy hunting flowed to the different constituencies contained within communal conservancies (Fig. 3). Based on detailed financial accounting data from 2011–2013, 58.3% of the financial benefits from tourism were in the form of jobs to conservancy members at joint-venture lodges, whereas 30.3% of the benefits were lodge contractual fees used for conservancy management and 11.5% were nonfinancial benefits to the community at large less.

In contrast, the majority (64.3%) of the benefits from hunting were in the form of cash for the operation of the conservancy, and a substantial fraction went to the community at large in the form of meat from hunted animals (32.0%, or approximately 1.4 million kg over the 3 years). Conservancies used income from trophy hunting and tourism in a variety of ways that benefited the entire community (Fig. 3), most importantly for the salaries of conservancy employees and for other conservancy operating costs, but also for compensation for wildlife conflict, payments to traditional authority structures, direct cash dividends, community-level projects, and infrastructure development. Our data suggest that operational costs, conservancy employee salaries, and the various benefits to the community at large were mostly derived from hunting because hunting operators paid fees from 2011–2013 of \$5.41 million (72% of the total), whereas tourism operators paid \$2.13 million (28%).

Currently, many conservancies cover their operating costs with income derived from trophy hunting and from tourism that is directed to conservancy management. Simulation of a trophy hunting ban showed a reduction in the number of conservancies with incomes greater than operating costs in 2013, from 74% (37 of 50) under the status quo to 16% (8 of 50) when conservancy income from hunting was eliminated. If this reduction were to occur throughout the country, it would cover nearly 50,000 km² (Fig. 4). When conservancy income from tourism was removed, the effect was again negative but

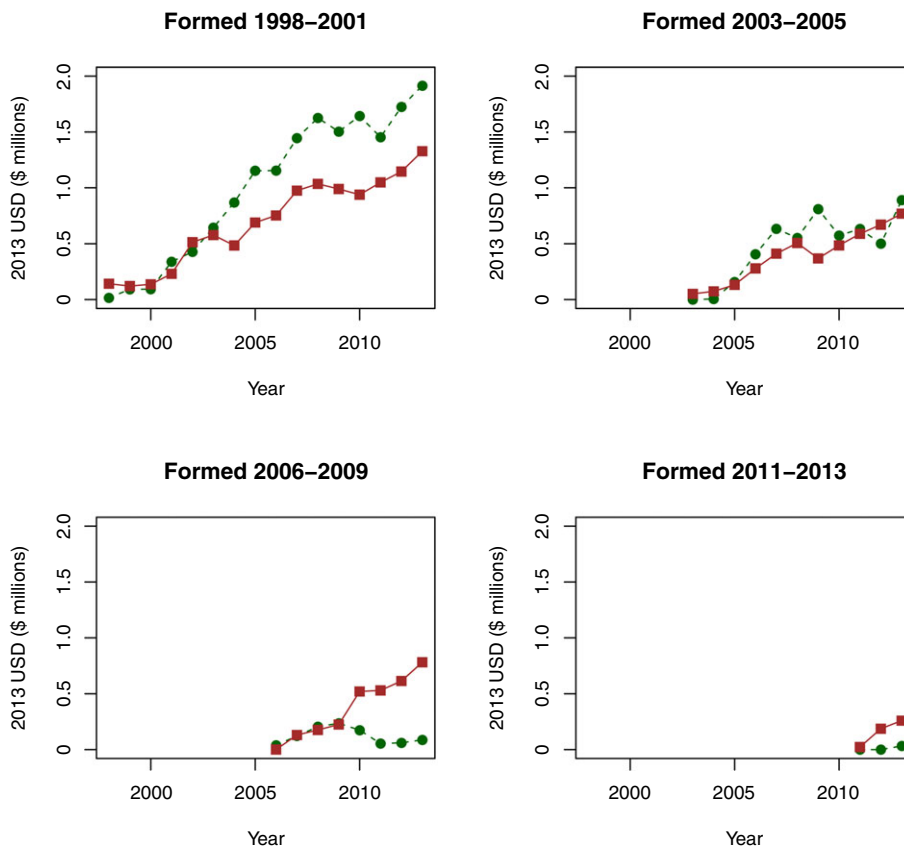


Figure 2. Total benefits from 1998–2013 for hunting (squares) and tourism (circles) across conservancies formed in 4 periods: (a) 1998–2001 ($n = 15$), (b) 2003–2005 ($n = 29$), (c) 2006–2009 ($n = 15$), and (d) 2011–2013 ($n = 18$).

Table 1. Statistical differences among time series of different metrics of total benefits (in U.S. 2013 dollars) generated from trophy hunting versus tourism on communal conservancies ($n = 52$) in Namibia.*

Variable	Hunting	Tourism	<i>t</i>	<i>P</i>
Benefits in 2013 (U.S.\$ 2013)	41,453	56,255	-0.91	0.36
Trend (linear regression) of annual change (U.S.\$ 2013)	2458	3954	-1.39	0.17
Volatility (root mean square error) of change over time (U.S.\$ 2013)	79,192	82,501	-0.16	0.83
Average annual gain (U.S.\$ 2013)	8723	11,175	-0.93	0.36
Maximum annual gain (U.S.\$ 2013)	47,420	68,694	-1.19	0.23
Lag (years) between conservancy formation and first benefits	2.81	5.71	-3.29	0.001
Number of conservancies specializing in hunting or tourism	28	6	—	—

*Excluding conservancies that had not generated any benefits from either hunting or tourism.

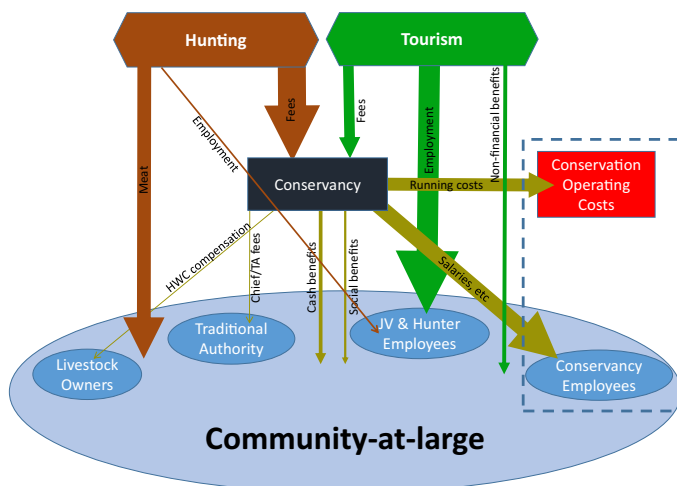


Figure 3. The flow of benefits to various sectors of a stylized local community in Namibia (widths of arrows proportional to dollar values of flows to conservancies from 2011 to 2013; brown, hunting benefit; green, tourism benefit; olive green, flows with a mix of hunting and tourism benefits; dashed rectangle, reinvestment of income into conservation activities; JV, joint venture tourism; HWC, human wildlife conflict; TA, traditional authority). Specific stakeholders (blue ovals) and the overall community at large receive the benefit flows indicated by the arrows ending in those ovals. Income to the conservancy committee (black rectangle) comes from both sectors and is redistributed as indicated, including to cover conservation operating costs (red square).

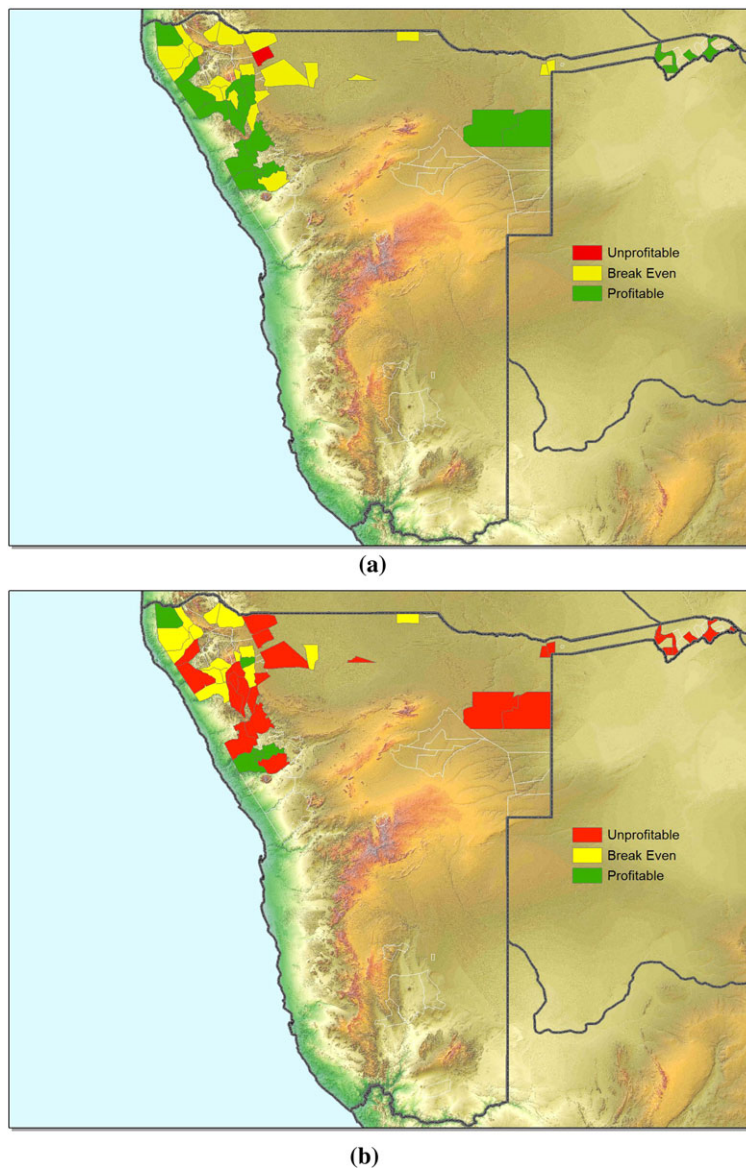


Figure 4. Revenues minus operating costs for 50 communal conservancies for which detailed management cost data were available in 2013 under (a) the status quo and (b) a simulated trophy hunting ban. Break-even conservancies indicate those for which revenues and operating costs are within \$5000 of one another.

less marked; 59% of conservancies remained able to cover their operating costs.

Finally, of the 303 animals harvested by trophy hunters in 2013, individuals from 2 of the Big-5 (buffalo [*Syncerus caffer*], elephant [*Loxodonta africana*], lion [*Panthera leo*], leopard [*Panthera pardus*], rhinoceros [*Diceros bicornis* and *Ceratotherium simum*) species hunted in Africa, buffalo and elephant, accounted for 78.3% of hunting revenue; over 55% was attributable just to elephants (Table 2).

Discussion

Despite the importance of both tourism and hunting to conservation, and the debate surrounding their implementation, we are the first study to use detailed quantitative data across multiple jurisdictions and over a lengthy

time span to directly compare the financial performance of these two activities. Our data from 77 Namibian conservancies from 1998 to 2013 showed that trophy hunting and tourism reached similar aggregate levels but began to generate benefits at different times (earlier vs. later in a conservancy's life-span) and flowed to different beneficiaries (community management committees and the community at large vs. individual employees). Previous work in Namibia has demonstrated that benefits from hunting and tourism are also spatially differentiated; conservancies are more likely to generate benefits from hunting in areas with diverse wildlife and Big-5 species, whereas the presence of black rhinoceros (*Diceros bicornis*) and broader environmental conditions (distance to tourist routes, topographical diversity, and rainfall) are correlated with higher benefits from tourism (Naidoo et al. 2011b). In addition, the first conservancies established were typically those with the highest potential to

Table 2. Number of animals killed by trophy hunters in 2013, by species; average payment made per animal; and the estimated overall contribution of each species to trophy hunting income on communal conservancies in Namibia.

<i>Species</i>	<i>Animals hunted</i>	<i>Payment per animal (2013 U.S.\$)</i>	<i>Revenue (2013 U.S.\$)</i>	<i>Percentage of total</i>
Baboon	17	25.62	435.58	0.03
Black-backed jackal	6	23.65	141.91	0.01
Black-faced impala	8	723.55	5788.38	0.3
Blue wildebeest	12	382.26	4587.14	0.3
Buffalo	71	5497.93	390,352.70	23.4
Burchell's zebra	22	388.69	8550.10	0.5
Bushbuck	1	746.89	746.89	0.04
Common impala	22	180.91	3980.08	0.2
Crocodile	22	1321.06	29,063.28	1.7
Common duiker	5	116.18	580.91	0.03
Elephant	69	13,296.47	917,458.09	54.9
Gemsbok	60	274.79	16,490.46	1
Giraffe	7	677.80	4744.50	0.3
Hartmann's mountain zebra	67	356.54	23,887.76	1.4
Hippopotamus	31	2068.26	64,117.43	3.8
Klipspringer	9	282.88	2546.27	0.2
Kudu	55	449.38	24,718.57	1.5
Red lechwe	13	1190.35	15,474.59	0.9
Leopard	11	2210.79	24,318.88	1.5
Lion	2	11,371.89	22,743.78	1.4
Ostrich	14	102.49	1435.17	0.1
Reedbuck	3	591.29	1773.86	0.1
Roan antelope	9	4385.68	39,470.95	2.4
Sable antelope	9	5290.46	47,614.11	2.8
Spotted hyena	5	297.30	1486.41	0.1
Springbok	89	154.56	13,756.85	0.8
Steenbok	10	89.73	897.61	0.1
Warthog	17	187.03	3179.46	0.2
Waterbuck	1	1037.34	1037.34	0.1
Totals	667	—	1,671,379.05	100

generate benefits from wildlife, and, as with our cohort results, older conservancies generate higher levels of aggregate benefits than younger ones (Naidoo et al. 2011a; Humavindu & Stage 2015).

We found that tourism and hunting both made substantial and separate contributions to the economic welfare of rural communal residents; the former was weighted toward employment and wages and the latter toward governance structures and management costs. A focus on either one or the other would lead to substantial reductions in overall benefit generation and incentives for wildlife conservation throughout Namibia. For much of Africa and other parts of the world, Westerners tend to view tourism as the dominant wildlife-based development paradigm for delivering a sustainable flow of benefits to local communities living with wildlife or near protected areas (Kiss 2004; Hawkins & Mann 2007). Similar to the results of studies of private landholders (Lindsey et al. 2013b) and national economies (Barnes et al. 2002; Lindsey et al. 2007), our results showed it is important to recognize that the direct benefits of hunting are roughly similar in magnitude to those of tourism for communal conservancies in Namibia.

Beyond this aggregate overall similarity between the benefits of hunting and tourism, there are important dif-

ferences in scale and sequencing between the two activities. For the typical conservancy, benefits from hunting are generated quickly, within a few years of formation. In these early years of a conservancy, income from trophy hunting is critical for the management of the area, and the meat from hunted animals makes tangible the economic benefits that wildlife conservation can deliver to conservancy members. Benefits from tourism take twice as long to develop, due to the time needed for the recovery of wildlife populations, and the investments in both physical (i.e., lodges and other infrastructure) and human capital required to host high-end tourism in communal areas. Few conservancies (12%) specialized in tourism; most conservancies generating benefits from tourism also generated benefits from hunting. In contrast, over half (54%) of the conservancies generating benefits in Namibia did so from hunting alone, because hunting can be sustained in areas with relatively low densities or visibilities of wildlife, and in landscapes that are unappealing or inaccessible for photographic tourism (Lindsey et al. 2006). Because these conditions characterize much of the African protected- (in the widest sense) area estate, it follows that preventing or discouraging trophy hunting would remove possible incentives for conservation across a large swathe of the continent

where nature-based tourism is not viable (e.g., Blom 2004).

Benefits from trophy hunting and tourism also accrue to different stakeholders within communal conservancies. Benefits from tourism were mainly in the form of employment income to conservancy members who are hired to work at lodges built on conservancy land. Although these employees normally come from among a group of conservancy members nominated by the conservancy, ultimately staff are hired based on their knowledge, communication skills, and potential. Jobs of any kind are extremely rare in remote rural areas and thus highly sought after; therefore, tourism is viewed very favorably by local residents who are employed in the industry (Suich 2010; Silva & Motzer 2015). In contrast, agreements between communities and hunting operators provide significantly higher levels of income for conservancy management, as well as greater nonfinancial benefits (largely from meat) distributed directly to the community at large.

The income to management committees is essential; without it, most communal conservancies in Namibia would be unable to cover their operating costs (which three-quarters of the 50 conservancies we assessed were doing). Conservancies unable to cover their operating costs will likely cease to pursue conservation as a viable land use because without conservancy income, game guards cannot be paid, management and monitoring plans cannot be developed and instituted, the sense of local ownership over natural resources dissipates, and wildlife becomes much more vulnerable to declines from poaching and overharvest. This link between income from hunting and the conditions and incentives that permit wildlife to persist as an economically viable land use is critical but often unrecognized. Our data also show that almost 80% of hunting benefits are delivered by two species (elephant and buffalo); elephants alone generate over 50% of all hunting benefits from an increasing population base (7500 individuals in 1995 to over 20,000 in 2012 [Craig 1999; Ministry of Environment and Tourism 2012]). Therefore, even a targeted hunting ban on elephants or an import ban such as those that currently prevent the import of elephant trophies from Tanzania and Zimbabwe into the United States is likely to have a very negative impact on Namibia's CBNRM program by severely undermining conservancy governance structures and incentives for conservation. Anecdotal accounts of the impact of Botswana's 2014 hunting ban suggests that similar negative consequences (an increase in poaching for meat and trade and increased collaboration of local communities with international poaching gangs) may be occurring there (Somerville 2015).

Although we found there were impressive financial gains from trophy hunting, the sustainability (both ecological and economic) of these operations on communal lands in Namibia is rightly of major concern. As such, it is regulated via annual estimates of species' popula-

tions and harvest quotas derived in agreement with local communities and the Ministry of Environment and Tourism (NACSO 2013). Although data from the various conservancy landscapes within the country indicate populations in these areas have generally increased since the advent of Namibia's CBNRM program (Naidoo et al. 2011b), evidence on possible negative impacts of trophy hunting on wildlife populations in other parts of Africa (Packer et al. 2010; Lindsey et al. 2013a) means that trophy hunting must be carefully monitored in Namibia to ensure the same does not happen. There have been no assessments on how trophy size or quality in particular species may be changing over time, a concern that has been raised for trophy hunting in Africa (Crosmary et al. 2013) and that may result in undesirable genetic changes within hunted populations (Coltman et al. 2003). It is therefore critical that data on the size and quality of trophy exports be analyzed for Namibia's CBNRM program to inform monitoring, evaluation, and management of the trophy-hunting industry. High-profile, apparently illegal hunts such as of lions on the borders of national parks in Zimbabwe, and ethically dubious practices, such as canned hunting of captive animals, also illustrate that the industry itself must play a greater role in addressing issues that throw the sector into dispute. Finally, growing human populations and a tremendous increase in elephant poaching for the international ivory market may eventually result in reduced quotas of elephants and therefore threaten the financial benefits communal conservancies have generated through trophy hunting.

The sustainability of photographic nature-based tourism in Africa and beyond has also come under scrutiny (Buckley 2004; Newsome et al. 2012). In Namibia relevant issues for ecological sustainability include impacts of intense wildlife viewing on animal behavior, localized environmental implications of the development of tourism infrastructure (lodges, campsites, roads, disposal facilities, etc.) in sensitive arid environments, and climate-change impacts from the carbon emissions of increasing numbers of international visitors. As with trophy hunting, there are few studies, particularly for the first two considerations, that have evaluated the sustainability of tourism initiatives on communal conservancies in Namibia. Furthermore, from a socioeconomic point of view nature-based tourism on communal lands in Namibia has been criticized as having power imbalances or elite capture issues that render communities unable to secure significant shares of the benefits (Hoole 2010; Lapeyre 2011), even though residents of conservancies with high benefit levels are themselves strongly supportive of tourism (Silva & Motzer 2015). Finally, to assess more fully the overall costs and benefits of wildlife conservation on communal lands in Namibia, there is a need for greater investigation of both human-wildlife conflict costs and who bears them, as well as the opportunity

costs of pursuing wildlife conservation as a land use versus alternative uses.

Despite these caveats, our results show that hunting and tourism generated similar aggregate levels of benefits for local communities in Namibia. Because these benefits occur at different times, in different places, and reach different sections of local communities, each are essential to the successful functioning of community-based natural resource management in Namibia. As with other contexts (Sandbrook & Adams 2012), recognizing that benefits from conservation to local communities take various pathways has important implications for conservation and the development of effective incentives. Further investigation is therefore desperately needed to examine the relative impacts of hunting and tourism in many others areas of conservation importance in sub-Saharan Africa.

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Supporting Information

The total benefits over time from hunting and tourism for each of Namibia's 52 communal conservancies formed by 2012 that have generated some level of benefits (Appendix S1) is available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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