

Possible relationships between the South African captive-bred lion hunting industry and the hunting and conservation of lions elsewhere in Africa

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The trophy hunting of lions is contentious due to increasing evidence of impacts on wild populations, and ethical concerns surrounding the hunting of captive-bred lions in South Africa. The captive-bred lion hunting industry in South Africa has grown rapidly while the number of wild lions hunted in other African countries has declined. In 2009 and 2010, 833 and 682 lion trophies were exported from South Africa, respectively, more than double the combined export (2009, 471; 2010, 318) from other African countries. There has been an associated increase in the prevalence of the export of lion bones from South Africa: at least 645 bones/sets of bones were exported in 2010, 75.0% of which went to Asia. Such trade could be problematic if it stimulated demand for bones from wild lions or other wild felids. Captive-bred lion hunting differs from wild lion hunting in that lions are hunted in smaller areas ($49.9 \pm 8.4 \text{ km}^2$ compared to 843 to 5933 km^2 , depending on the country), hunts are cheaper (US\$20 000–40 000 compared to US\$37 000–76 000 [excluding the costs of shooting other species and government charges]), shorter (3.3 compared to 14–21 days), success rates are higher (99.2% compared to 51.0–96.0%), and trophy quality is higher (skull length + breadth = 638.8 compared to 614–638 cm). Most clients perceive captive-bred and wild lion hunting to be different products but there is some overlap in markets: 48.7% of clients that had hunted captive-bred lions showed no preference regarding the type of future hunts. Owing to the size of the captive-bred hunting industry, even marginal overlap in demand could affect wild lion hunting significantly. If captive-bred lion hunting were ever prohibited, a transfer of demand to wild lion hunts could lead to elevated off-takes with negative impacts on wild populations. However, if off-takes of wild lions were held constant or reduced through effective regulation of quotas, increased demand could increase the price of wild lion hunts and strengthen financial incentives for lion conservation. These possibilities should be considered if future efforts are made to regulate captive-bred lion hunting.

Key words: animal welfare, game ranching, protectionism, safari hunting, sustainable use, *Panthera leo*.

INTRODUCTION

The continental African lion (*Panthera leo*) population has declined by at least 30% in recent decades, while the species' geographic range has shrunk by as much as 82% (IUCN 2006). Key causes for the decline include conflict with pastoralists over live-stock depredation, habitat destruction and frag-

mentation, and the loss of available wild prey (Ray *et al.* 2005). In addition, excessive trophy harvests have emerged as a threat in some areas (Packer *et al.* 2009). Lion populations are particularly sensitive to trophy harvests due to the social disruption and potential for infanticide by incoming males following removal of pride males (Whitman *et al.* 2007). Lions are hunted widely in southern and East Africa, with particularly significant

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off-takes in Tanzania, Zimbabwe, Zambia, and Mozambique (Loveridge *et al.* 2009). In addition, there has been rapid growth in the practice of hunting captive-bred lions in South Africa (Patterson & Khosa 2005). Attitudes towards trophy hunting of lions are widely divergent, with polar opinions held by the hunting industry and animal welfare organizations. Mainstream conservation organizations occupy a middle ground, appearing uncertain of the acceptability and effectiveness of trophy hunting as a tool for conservation (Lindsey *et al.* 2006). Controversy surrounding lion hunting is reflected by efforts to impose restrictions on the trading of lion trophies. For example, there was a proposal by Kenya to list lions on CITES Appendix I at the 13th conference of the parties (Nowell 2004) and, in 2011, a coalition of animal welfare organizations petitioned the U.S. government to list lions as 'endangered' pursuant to their Endangered Species Act (www.ifaw.org; accessed June 2011). Concurrent efforts are being made by animal welfare groups to pressure the European Union to prohibit the importation of lion trophies.

Controversy surrounding lion hunting is due in part to philosophical objections to hunting for sport among some organizations (Lindsey *et al.* 2006). However, there is increasing evidence of the negative impacts of trophy hunting on lion populations in some areas (Yamazaki 1996; Loveridge *et al.* 2007; Packer *et al.* 2011; Croes *et al.* 2011), but also recognition of the incentives created through the hunting of lions for the retention of land for wildlife in some countries (Lindsey *et al.* 2012a). There is significant controversy surrounding the practice of hunting captive-bred lions (also known as 'put and take' or 'canned' lion hunting) in South Africa. The majority of lions hunted in South Africa are captive bred and are hunted in small, fenced areas in which they have little chance of escape (Patterson & Khosa 2005). This practice has generated significant negative publicity for the hunting industry, particularly in South Africa. Partly as a response to the emergence of put and take hunting (and due to recognition of insufficient regulation of the hunting industry in general), the South African government developed the Threatened and Protected Species (ToPS) regulations (Cousins *et al.* 2010). The ToPS regulations prohibited put and take hunting, which is defined as involving captive-bred ToPS-listed species within 24-months of the animal(s) being released into an area (Government Gazette No 29657 Notice No R152). However, following promulgation

of the regulations, a series of legal challenges from the lion-breeding industry followed. These challenges were ultimately successful, with the effect that lions are no longer considered a listed large predator and so hunting restrictions pertaining to put and take hunts do not apply to lions (Predator breeders vs The Minister of Environmental Affairs [Case 1900/2007 and case 72/2010]) (Hargreaves 2010a). Consequently, the practice of hunting captive-bred lions, including within 24 months of release, continues.

The primary point of contention regarding captive-bred lion hunting appears to be welfare issues associated with raising lions specifically to be killed by hunters. The potential impact of captive-bred lion hunting on the wider conservation of lions has been largely overlooked, with the exception of attempts to justify the practice on the grounds that it may reduce pressure from hunters on hunts for wild lions (Hargreaves 2010b). A counter-argument is that reduced demand could potentially undermine the price of wild lion hunts, thereby reducing incentives for the conservation of wild lions in other African countries. An additional potential conservation impact of captive-bred lion hunting is through undermining the credibility of trophy hunting as a conservation-tool in general, at a time when so much contention surrounds the practice (Lindsey *et al.* 2007a,b).

This paper is part of a broader study on the trophy hunting of African lions, with sister papers on the economics of wild lion hunting (Lindsey *et al.* 2012a) and on the sustainability of wild lion hunting quotas (P. Lindsey, unpubl. data.). Here we explore the impact of captive-bred hunting on the wild lion hunting industry and on lion conservation more widely. Specifically, we use trophy export data, combined with client and hunting operator perceptions, to assess the extent to which the two markets overlap. In addition, we investigate the extent to which lion bones are exported. Lion bones represent a potential substitute for tiger *Panthera tigris* bones in the Traditional Chinese Medicine market, and trophy hunting provides a potential supply for that trade (Hargreaves 2010b).

METHODS

Export of lion trophies and areas where lions are hunted

Estimates of the number of lions and other trophy species exported as trophies were obtained from the CITES website (

apps.org/citestrade/trade.cfm, accessed April 2011). Data were restricted to exports of items listed as 'trophies' exported from all sources for any reason from each country to be consistent and conservative (sometimes lion trophies are exported under different descriptions). CITES export data were also obtained directly from the South African Department of Environmental Affairs to enable identification of the provinces from which hunting trophy exports were sourced.

Surveys of hunting operators and clients

Insights on various issues relating to the hunting of lions were obtained *via* a survey of hunting operators in the United States (Dallas and Houston Safari Clubs, Atlanta Africa hunting show), using a structured survey. The United States is the largest market for African hunting safaris, and most hunts are sold at hunting conventions. Clients were also surveyed at the Dortmund Hund und Jagdshow which is the largest hunting convention in Germany, another major market for hunting in Africa. Surveys were pre-tested before use and were conducted by four trained interviewers. Sampling technique followed that of Lindsey *et al.* (2006). An attempt was made to survey every African operator present who sells lion hunts, resulting in a sample of 76 operators (73.8% of the total), of which 27 were from South Africa. A total of 154 clients (106 from the U.S.A. and 48 from Germany) were also surveyed. At the end of the client survey, the mobility of respondents was categorized visually on a scale of low, medium and high, based on their age, weight (degree of obesity), and apparent physical fitness.

Lion trophy quality

Data on lion trophy quality from South Africa vs other African countries was obtained from the Safari Club International record book (<http://www.scirecordbook.org/login/index.cfm>, accessed July 2011).

RESULTS

Exports of lion trophies

The number of lion trophies exported from most African countries other than South Africa has declined in recent years (Fig. 1). By contrast, there has been a steep increase in the numbers of lion trophies exported from South Africa until 2008, after which the numbers have declined somewhat (Fig. 1). Nonetheless, in 2010, more than double

the number of trophies was exported from South Africa than from the rest of Africa combined. The majority of lion trophies are sent to the Americas, primarily to the United States (57.8% of South African lion trophies and 56.1% of those from elsewhere in Africa). The proportions of lion trophies exported from South Africa and other African countries to various markets differ ($\chi^2 = 373$, d.f. = 4, $P < 0.001$), with more of the former being sent to Asia and more of the latter being sent to other African countries (primarily South Africa, presumably *en route* to export elsewhere) (Fig. 2). Of South African lion trophies sent to Asia, 26.0% were sent to China, 23.4% were sent to Laos and 14.1% were sent to Vietnam (none of which are traditional hunting market countries; Lindsey *et al.* 2007a). South African lion trophies sent to Europe were most commonly sent to Spain (27.1% of exports to Europe) or Russia (12.6%), whereas non-South African trophies were primarily sent to Spain (28.4% of exports to Europe), France (13.3%) and Germany (11.2%).

Relatively few lion bones were exported from South Africa during 2000–2008 (89 sets of bones). However, during 2009 and 2010, 386 and 645 sets of bones were exported from the country, respectively, most (75.0%) of which went to Asia (67.7% to Laos, and 7.1% to Vietnam), Europe (15.4%) and the United States (9.2%).

Wild lions hunted in South Africa

South African operators estimated that 7.8 ± 1.57 wild lions are hunted annually in South Africa (0.9 and 1.1% of the totals exported in 2009 and 2010, the remainder being captive-bred). Wild lions were defined as those that are wild-born or which have been fending for themselves for at least two years following release into an area. Operators most commonly believed that wild lions are hunted along the Kruger National Park border (53.3% of South African operators) and in the Northern Cape (wild lions occur in the Kgalagadi Transfrontier Park in that province).

The nature of captive-bred vs wild lion hunting

Lion hunting outside of South Africa is typically structured such that clients are required to pay for a safari of a set number of days (14–21) at set daily rates (US\$1800–3200/day) in addition to a trophy fee for the lion (US\$4500–23 000) (Table 1), trophy fees for any other species shot on the hunt and in some cases, a variety of government fees. Total mean minimum costs for lion hunts outside of

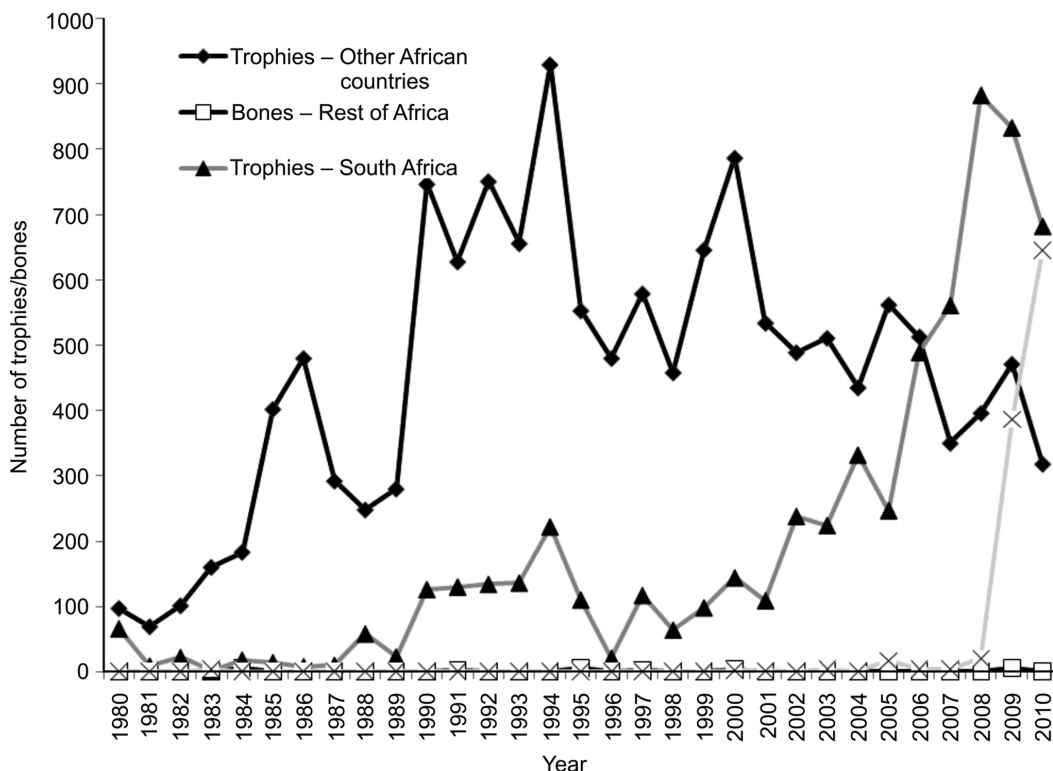


Fig. 1. Exports of lion trophies and bones from South Africa and other African countries (Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Ethiopia, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe) during 1980–2009.

South Africa range from US\$37 000 (Cameroon) to US\$76 000 (Tanzania) (excluding government fees and trophy fees for other species shot on the hunt) (Table 1). In South Africa, by contrast, lion hunts are typically sold as all inclusive packages, with no set time limit. When asked to provide the price of lion hunts during surveys, operators typically provided a range as prices depending on trophy size. The mean (\pm S.E.) minimum price quoted was US\$19 472 \pm 1221 ($n = 24$), the mean mid-price was US\$30 542 \pm 1,896, and the mean maximum price was US\$39 588 \pm 3523, suggesting that lion hunting in South Africa is typically cheaper than elsewhere (F -ratio = 33.0, d.f. = 1, $P < 0.001$).

Approximately 33.5% of lions hunted as trophies in South Africa are females. Outside South Africa, the hunting of lionesses is only permitted in Zimbabwe and Namibia (P. Lindsey, unpubl. data). Lions are typically bred by South African landowners who then either market hunts directly (if they are registered as a hunting operator) or sell hunting rights to operators. Operators indicated that

80.7% of income from captive-bred lion hunting normally goes to the breeder (who is normally the owner of the land on which the hunt takes place), the remainder accruing to the operator.

The areas in which lions are hunted in South Africa are markedly smaller than elsewhere (F -ratio = 13.4, d.f. = 1, $P < 0.001$) (Table 2). Similarly, success rates of lion hunts are higher in South Africa and the number of days typically taken to hunt lions is lower ($\chi^2 = 68.9$, d.f. = 2, $P < 0.001$) (Table 2). Trophy quality is higher in South Africa than in other countries (F -ratio = 138, d.f. = 1, $P < 0.001$, Table 3). Where lions are hunted in South Africa, operators reported that the animals hunted are usually released into the hunting area 34.0 ± 19.0 days prior to the hunt. However, in 60% of cases, lions are introduced into the area ≤ 7 days prior to the hunt. According to CITES export data, the majority of lion trophies are exported from the North West (63.5%), Limpopo (22.3%), Eastern Cape (5.8%), Free State (4.0%), Mpumalanga (2.3%), Kwa-Zulu-Natal (1.0%) and Northern Cape (0.7%) provinces.

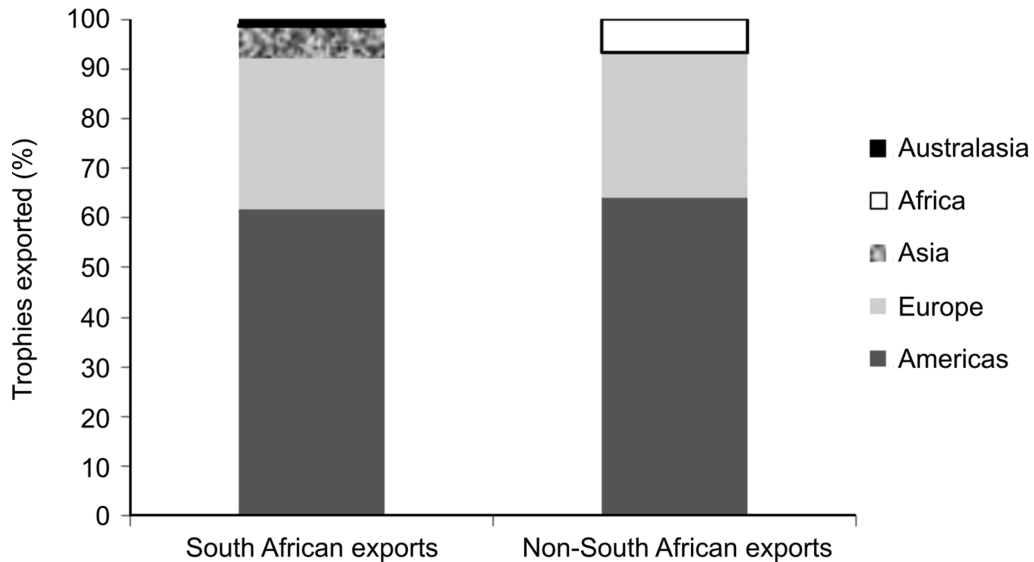


Fig. 2. The destination of lion trophies exported from Africa.

Operator and client perceptions of captive-bred hunting

Most (82.9%) operators (and all South African operators) felt that clients understand the differences between a captive-bred lion hunt and a wild lion hunt: Most (80.9%) South African operators claimed that they explain to their clients exactly what the hunt entails. However, some operators (14.3% of South African, and 33.3% from other African countries) felt that clients are misled when being sold a captive-bred hunt in South Africa as to what it actually entails.

Most (80.9%) clients said that they were aware of what captive-bred lion hunting entails. Sixty-four per cent (64%) of such clients described captive-bred hunting as being practised in fenced areas, 49.4% thought it involves hunting captive animals, 29.1% believed it involves animals raised specifi-

cally to be shot and 8.1% felt that it involves shooting drugged lions. Only 18.6% of clients felt that captive-bred hunting of lions and wild lion hunting was essentially the same thing. Sixty-seven per cent (66.7%) said that their last lion hunt was for a wild animal, 30.7% indicated their last hunt was for a captive-bred lion, and the remainder (2.6%) were not sure if the hunt was for a wild or captive-bred lion. The nature of clients' last lion hunt (captive-bred vs wild) was influenced by their nationality (54.6% of German clients' last lion hunts were captive-bred compared with 16.7% of United States clients) and their degree of mobility (32.0% of clients who hunted captive-bred lions had high mobility compared to 45.6% of clients who had hunted wild lions) ($\chi^2 = 14.2$, d.f. = 2, $P < 0.001$).

Seventy-six per cent (75.9%) of clients would

Table 1. Mean length and cost of lion hunts in various African countries (from Lindsey *et al.* 2012).

Country	Minimum length of lion hunts	Daily rates (US\$)	Trophy fee (US\$) ^a	Total hunt cost (US\$) ^b
Cameroon	15	2179 ^a	4 800 ^a	37 485
Mozambique	18	1800	13 286	45 686
CAR	14	3163 ^a	4 520 ^a	48 802
Zimbabwe	20	2050	11 714	52 714
Zambia	21	2385	5 186	55 271
Namibia	20	1975	22 940	62 440
Tanzania	21	3061	11 835	76 116

^aData from a web survey of hunting operators (Cameroon, $n = 4$; CAR, $n = 5$).

^bExcluding government fees, expenditures on trophy fees for other species shot during the hunt, dipping and packing, travel, or taxidermy.

Table 2. Mean estimated hunting success rates and number of days taken to shoot lions on trophy hunts (from surveys of operators) and mean sizes of hunting blocks in which lions are hunted (see table footnote for sources of information).

	Success rates (mean \pm S.D.) ^a (%)	Days to get lion ^a	Size of hunting blocks ^b (km ²)
South Africa	99.2 \pm 2.6	3.32 \pm 0.33	49.9 \pm 8.4
Zimbabwe	96.0 \pm 9.5	9.63 \pm 0.63	843 \pm 151
Zambia	86.9 \pm 9.4	12.0 \pm 0.89	5933 \pm 1610
Mozambique	77.8 \pm 24.4	10.7 \pm 0.81	2900 \pm 325
Central African Republic	75.0 \pm 0	5.0 \pm 0	3026 \pm 303
Tanzania	61.3 \pm 16.2	12.0 \pm 1.0	1753 \pm 116
Namibia	51.0 \pm 25.5	8.72 \pm 1.8	1623 \pm 433
Benin	No data	No data	868 \pm 161
Burkina Faso	No data	No data	658 \pm 126
Cameroon	No data	No data	No data

^adata from operator surveys (South Africa $n = 27$; Zimbabwe $n = 18$; Zambia $n = 17$; Mozambique $n = 11$; Central African Republic $n = 2$; Tanzania $n = 14$; Namibia $n = 12$).

^bdata from Chardonnet *et al.* 2009; Mesochina *et al.* 2010a,b; C. Packer, unpubl. data; www.nacso.org, accessed May 2011; P. Lindsey, unpubl. data). Note that data for Mozambique and Zambia excludes game ranches, and for Zimbabwe excludes CAMPFIRE areas, for which data on sizes are unavailable.

prefer their next lion hunt to be for a wild lion, 17.0% preferred a captive-bred lion, and 7.1% had no preference. Preference for a wild lion in future was influenced by the nature of their previous hunt(s): 96.0% of clients who hunted wild lions previously would prefer a wild lion hunt, whereas only 20.0% of clients who had hunted captive-bred lions would prefer a wild lion hunt in future ($\chi^2 = 48.9$, d.f. = 1, $P < 0.001$). Clients were asked to indicate the strength of their preference on a 0–5 scale (0 being no preference and 5 being strong preference). Respondents wishing to hunt wild lions had a stronger preference (mean score 4.64 ± 0.1) than those wishing to hunt captive-bred

lions (4.0 ± 0.2) ($\chi^2 = 40.4$, d.f. = 4, $P < 0.001$).

Clients were asked if they would still investigate the possibility of buying a lion hunt of the kind other than the one they specified preference for. Only 5.2% of clients who expressed a preference for wild hunts would investigate captive-bred hunts, whereas 48.9% of clients who expressed preference for captive-bred hunts would investigate wild hunt packages ($\chi^2 = 34.0$, d.f. = 1, $P < 0.001$).

The mean minimum percentage chance of success that clients would consider to be acceptable when purchasing a lion hunt was 51.3%, and was higher among clients who wished to hunt in South Africa (67.7% compared with 43.7%, d.f. = 1, F -ratio = 21.1, $P < 0.001$). The countries that clients most commonly indicated that they wish to hunt lions in on their next hunt were: South Africa (32.5%); Tanzania (32.5%); Zimbabwe (22.5%) and Zambia (17.5%). Clients wishing to hunt in South Africa more commonly cited high trophy quality (71.4% compared to 26.9%) and the high success rates (28.4% compared to 7.7%) as reasons for their choice of hunt location than clients wishing to hunt elsewhere ($\chi^2 = 6.1$, d.f. = 2, $P < 0.001$).

Pros and cons of captive-bred hunting and influence on hunting elsewhere

Operators were asked to provide their perceptions of the potential benefits and costs of captive-bred lion hunting to wider lion conservation. The primary perceived benefit associated with cap-

Table 3. Mean Safari Club International record book trophy sizes (measured as skull length + breadth) for the seven main lion hunting countries during 2000–2009.

Country	n	Mean skull length + breadth (mm) \pm S.E.
South Africa	366	638.8 \pm 1.9
Namibia	20	637.5 \pm 5.2
Mozambique	28	634.3 \pm 4.9
Ethiopia	12	624.3 \pm 6.9
Botswana	243	623.7 \pm 1.5
Zimbabwe	268	623.3 \pm 1.5
Tanzania	481	619.1 \pm 1.1
Zambia	308	616.0 \pm 1.3
C.A.R.	36	615.6 \pm 3.4
Sudan	22	614.6 \pm 4.1
Kenya	33	614.0 \pm 3.9

Table 4. Perceived pros and cons associated with captive-bred lion hunting among hunting operators.

Pros of put and take lion hunting	South African	Other African
Takes hunting pressure off wild lion populations	30.8	44.7
Contributes to the economy and creates employment	23.1	8.5
The breeding of lions ensures their continued existence	15.4	10.6
There are no benefits associated with captive-lion hunting	3.8	15.6
Generates profit for South African operators	0.0	10.6
Provides a good hunting experience for clients	15.4	0.0
Cons of put and take hunting		
Ethical concerns	7.4	40.5
Negative publicity for the trophy hunting industry	11.1	33.3
There are no cons	29.6	4.8
Put and take hunting should not be classed as hunting	3.7	19.0
Put and take operators mislead clients into believing they hunt wild lions	7.4	7.1
There are unscrupulous operators with questionable practices within the put and take lion hunting industry	11.1	4.8

tive-bred lion hunting is that it reduces hunting pressure on wild lion populations, and contributes to the South African economy, whereas the main perceived costs are ethical concerns and the negative publicity generated for the hunting industry as a whole (Table 4).

Operators were asked to provide their thoughts on the likely impacts on lion hunting and lion conservation elsewhere if captive-bred hunting were ever banned in South Africa (Table 5). Many South African hunting operators felt that the closure of captive-bred hunting in their country would result in the loss of most captive lions, and would cause increased pressure and off-takes on wild lions

elsewhere in Africa (Table 5). Non-South African operators were more likely to believe that closing captive-bred hunting would increase demand for lion hunting elsewhere in Africa (64.0% compared to 12.0%), but less likely to believe that such closure would lead to increased quotas or off-takes in other countries (38.0% compared to 74.1%) ($\chi^2 = 23.7$, d.f. = 2, $P < 0.001$).

If captive-bred lion hunting in South Africa were closed down, 52.7% of operators believed that the practice would shift to another country, the most commonly suggested candidate nations being Zimbabwe (49.1% of operators), Namibia (24.6%) and Mozambique (24.1%). Forty-seven per cent

Table 5. Operators' perceptions of the likely impact on lion conservation in South Africa and elsewhere in Africa, and on lion hunting elsewhere in Africa if captive-bred hunting in South Africa was banned.

	South African	Other African operators
Impacts on lion conservation in South Africa		
Reduced lion numbers	35.3%	Not asked
Captive populations lost	58.8%	Not asked
Impacts on lion conservation elsewhere in Africa		
Increased hunting pressure on wild lions/increased off-takes	74.1	38.0
No effect	7.4	23.3
Increased demand for and thus value of wild lions, creating elevated incentives for conservation	0	10.8
More illegal/unethical hunting activities	7.4	6.1
Impacts on lion hunting elsewhere in Africa		
Increased prices	49.1	52.2
Increased demand	12.0	64.0
No impact	16.0	13.7

(46.7%) of operators believed that captive-bred lion hunting already occurs outside South Africa, with Zimbabwe (48.4%) and Namibia (20.5%) being the countries most commonly identified.

DISCUSSION

Limitations of our data

The authors recognize that neither the limited market information, nor the survey results represent sufficient data from which to draw firm conclusions about the relationships between the markets for wild and captive-bred lion hunting. During initial attempts to assess price elasticities of demand for lion hunting, there were simply too few observations for any meaningful interpretation.

Growth of the put and take lion hunting industry

The captive-bred lion hunting industry has grown significantly, to the point where almost twice the number of lion trophies are exported from South Africa as from all other African countries combined. The scale of off-take is such that more lions are hunted in both the North West and Limpopo provinces than in Tanzania or Zimbabwe, the two countries where most lions are hunted outside South Africa (P. Lindsey unpubl. data). Furthermore, the CITES data may underestimate the true extent of exports of lion trophies (e.g. Hargreaves [2010b] suggested that 944 were exported in 2008). The spike in lion trophy exports from South Africa in 2008 (which likely reflects hunting carried out in 2006–2007) may have been partly due to an attempt to sell off as many lions as possible prior to the expected prohibition of captive-bred lion hunting (Taljaard 2009), though the industry had grown steeply for several years prior to the legal challenges. The number of lions exported in 2010 was lower than in 2009 and 2008, though the data for that year (on both lion trophies and bones) may not be fully complete as 'the most recent year for which comprehensive trade statistics are available is normally two years before the current year' (http://www.unep-wcmc-apps.org/citestrade/docs/CITESTradeDatabaseGuide_v7.pdf, accessed April 2012).

Captive-bred lion hunting is supported by a significant lion breeding industry. In 2008, an estimated 3596 lions were kept in 174 breeding facilities in South Africa (Taljaard 2009). The lion breeding and hunting industry was estimated to generate a mean revenue of US\$11.2 million

(ZAR 75.5 million) directly (and US\$33.8 million [ZAR 226.7 million] including multiplier effects) from 2005–2007 and to have created 220 direct jobs (Taljaard 2009). Economic outputs of the captive-bred lion industry can be assumed to have increased significantly, as the mean number of lions exported from South Africa in 2008–2010 (799 ± 60) was almost double the mean during the period (406 ± 97) analysed by Taljaard (2009). The economic benefits are potentially significant because the main beneficiary provinces (North West, Limpopo and Free State) are among the poorest in South Africa (Taljaard 2009). However, ethical concerns and negative publicity associated with captive-bred lion hunting could potentially easily off-set gains by disrupting much larger and more economically significant industries such as ecotourism and mainstream trophy hunting.

Differences between wild and captive-bred hunting

There are a number of key differences between captive-bred and wild lion hunting. First, captive-bred hunts are cheaper than wild lion hunts. The price difference is exacerbated when one considers that a variety of other species are typically hunted on wild lion hunts (Booth 2009), which can potentially increase the price of a hunt by 25–100% (Lindsey *et al.* 2012a). In addition, South Africa and its local hunting destinations are more accessible than most other areas in Africa, due to the abundance of direct and comparatively cheap international and domestic flights. Wild lion hunts also typically have a number of costly government fees attached to them which are absent from South African captive-bred hunts (e.g. Tanzania Tourist Hunting Regulations 2010). Captive-bred hunts are shorter than wild hunts, and so opportunity costs for visiting hunters associated with the hunt are lower than those for wild lion hunts which have lengthy minimum hunt durations (14–21 days), making them easier for clients with limited vacation time.

Captive-bred hunts are also virtually guaranteed to result in a kill, having a success rate of 99.2%. By contrast, success rates elsewhere on the continent are lower (51.0–96.0%) and so clients pay large sums for a hunt on which they stand a fair chance of not securing a trophy. Finally, captive-bred lion hunts yield larger trophies than wild lion hunts. These factors help explain the popularity of captive-bred lion hunts, despite the negative publicity and potential stigma surrounding the

practice (e.g. <http://edition.cnn.com/exchange/blogs/in.the.field/2007/06/shooting-lions.html>, accessed August 2011).

Enhanced trophy size in captive-bred lions may be achieved through the provision of a consistent supply of food during their growth. However, selective breeding of wild animals to create large trophies is a widespread phenomenon on South African game ranches (Cousins 2010) and is likely practised with captive lions – as suggested by the advertising of opportunities for the hunting of colour variants, such as ‘white lions’ (e.g. <http://www.africahunting.com/great-deals-hunts-world-wide/3182-rare-white-lion-hunt.html>, accessed August 2011). Genetic manipulation of lions to produce large trophies would represent a negative conservation impact from the captive-bred lion hunting industry if those animals were allowed at some stage to mix with wild populations.

Extent of market overlap between captive-bred and wild lion hunting

As a result of the differences between captive-bred and wild lion hunts, and supported by the survey results, the authors hypothesize that the markets for the two types of hunts are generally different. Most South African operators claim to clearly explain to clients what their lion hunting experience will entail (a suggestion corroborated by most operators from other countries). In addition, most clients were able to identify the key differences between the two types of hunt. Such awareness has doubtlessly been increased over recent years due to media coverage of captive-bred lion hunting in South Africa. Finally, there are some differences in the clientele of captive-bred and wild lion hunts. For example, captive-bred hunting appears more popular among less physically mobile clients (presumably due to the comparative ease of hunting a lion in an enclosure), and a greater proportion of captive-bred lion hunters come from Russia and Asia. As a caveat to the last point, however, Asia is not a traditional market for trophy hunting safaris, and so exports of ‘trophies’ to that continent may be due to the mislabelling of other lion products in the CITES database.

Owing to the differences in the nature of captive-bred vs wild lion hunts, and strong preferences of clients for one or the other type, it would appear as though the bulk of the captive-bred lion hunting market is not transferable to wild lion hunting. However, there may be some overlap. Almost half of

clients who prefer captive-bred hunting indicated that they would still investigate wild lion hunts when purchasing a safari and 7.1% of all clients indicated that they had no preference regarding the type of lion hunts. Twenty per cent of clients who had hunted captive lions previously would prefer to hunt wild lions in future. In addition, the majority of non-South African operators felt that in the absence of the South African captive-bred lion hunting industry, demand for wild lion hunts elsewhere would increase. If captive-bred lion hunting was ever closed down, a proportion of clients who have a strong preference for captive-lion hunts may investigate wild lion hunts in the absence of their preferred option. Owing to the large size of the captive-bred lion hunting industry, even if a small proportion of the market was transferable, the increase in demand for wild lion hunts could be significant if the hunting of captive-bred lions was ever prohibited. A shift of 20% of the captive-bred market could lead to an increase of 42.9% in the demand for wild lion hunts.

Elevated demand for wild lion hunting could have either positive or negative implications for the conservation of wild lions both within and outside South Africa. Elevated demand for lion trophies could confer negative conservation consequences where lion hunting is poorly regulated and/or where quotas are excessive. Lion off-takes have already been shown to be excessive in parts of Cameroon, Tanzania, Zambia and Zimbabwe (Yamazaki *et al.* 1996; Loveridge *et al.* 2007; Packer *et al.* 2011; Croes 2011), and elevated off-takes could exacerbate the situation. Mean quotas are currently higher than the recommended 0.5/1000 km² in all countries except the Central African Republic (P. Lindsey, unpubl. data). An increase in demand for wild lions within South Africa could lead to an increase in hunting of the species on private and communal lands adjacent to protected areas such as the Kruger National Park and the Kgalagadi Transfrontier Conservation Area, which could create sink effects similar to those seen around Hwange NP in Zimbabwe (Loveridge *et al.* 2007). Such hunting would not necessarily rely on there being viable populations in hunting grounds adjacent to parks, as lions can be easily lured with the use of baits or calls and perimeter fencing is often poorly maintained and ineffective at controlling the movement of predators (Lagendijk & Gussett 2008; Lindsey *et al.* 2012b).

Conversely, in areas where lion hunting is well

managed, elevated demand for wild lion hunting through the closure of captive-bred lion hunting could potentially yield positive outcomes for lion hunting through elevated prices and thus increased incentives for conservation of the species. Lions are the most expensive species to hunt other than rhinoceroses (*Diceros bicornis/Ceratotherium simum*) and elephants with exceptional tusks (Booth 2009). Further price increases would make the species extremely valuable and could create strong incentives for maintaining populations of the species and for the retention of wildlife-based land uses. Such incentives could have a particularly marked impact in areas where people living with lions benefit from hunting of the species, as is the case where lions are hunted on private land or in some areas of communal land, such as the Namibian conservancies (Jones & Weaver 2009). In some scenarios, however, such as the open and game-controlled areas of Tanzania, and Game Management Areas of Zambia, communities are largely excluded from the benefits of hunting and their tolerance of lions would thus be unlikely to be affected by the price of lion trophies in the absence of industry reforms (Lewis & Alpert 2007; Nelson *et al.*, in press).

For lion conservation to benefit from increased demand for lion trophies, total available supply of wild lions on hunting quotas would need to decline or remain constant. This would occur if the number of lions made available for hunting is not determined by price, but by conservation considerations. To achieve this, authorities and operators would need to ensure that off-takes are sustainable by imposing, and enforcing, maximum harvests (*e.g.* 0.5–1.0/1000 km² in Tanzania, Packer *et al.* 2011) and/or imposing minimum age limits on lions that may be hunted, as has been implemented in the Niassa Reserve in Mozambique and as was recently passed as law in Tanzania (Begg & Begg 2009; Tanzania Tourist Hunting Regulations 2010).

Captive-bred lion hunting and the lion bone trade

The possibility exists that lions bred at facilities where captive-bred lion hunting occurs may be used to supply bones for trade in Asia for Traditional Chinese Medicine. In China, there is a significant demand for medicines containing tiger bones (Gratwicke *et al.* 2008). ‘Tiger bone’ wine is often sold in China with the words ‘*Panthera leo*’ printed on the labels (indicating that lion bones are used as a substitute), and the sale of products with lion

bones is not illegal in China (Gratwicke *et al.* 2008). Our results show that the number of bones exported from South Africa has grown in recent years, suggesting that captive lion breeders may have begun to capitalize on demand from Asia. In addition, some lion ‘trophies’ have been exported to Asia. However, such instances could potentially be due to a mis-categorization of lion products in the CITES database as Asian nationals do not traditionally form a significant component of the market for trophy hunting in Africa. Unlike the situation with rhinoceros hunting, where trophy hunting has been used as a conduit for rhino horn to enter Asian markets (Milliken 2009), lions (unlike rhinos) are listed on CITES Appendix II, meaning that export permits for bones could be acquired without having to necessarily sell a lion hunt. There are likely to be large numbers of lion bones available for export from captive lion breeding institutions from lionesses and non-trophy males that are not hunted as trophies, and as by-products from animals shot as trophies (as hunting clients typically only export the skull and skin from their trophy animal).

From a conservation perspective, trade in lion bones from captive institutions in South Africa to Asia would be cause for concern if it were to stimulate harvest of wild lions or other felids to supply the bone trade. The market preference in China for bones from wild, rather than captive, felids could result in such a stimulus (Gratwicke *et al.* 2008). Conversely, if the supply of bones from captive lions in South Africa was reduced through restrictions on that industry, demand for bones from wild lions could feasibly increase.

CONCLUSIONS

The captive-bred lion hunting industry has developed at a time when there is increasing scrutiny regarding the acceptability and effectiveness of trophy hunting as a conservation tool. Ethical issues associated with captive-bred lion hunting undermine the credibility of the wider African trophy hunting industry (Loveridge *et al.* 2009). Some trophy hunting organizations have attempted to publically distance themselves from the practice and differentiate between the shooting of captive-bred lions and that of wild lions. For example, Rowland Ward refuses to admit canned lion trophies into their record books (G. Damm, pers. comm., June 2011), Safari Club International differentiates between lions hunted behind fences (in South African and Namibia) and ‘free-range’

lions (H. Atkinson, pers. comm., June 2011) and the Boone & Crockett club has issued a public condemnation of the practice (http://www.boone-crockett.org/huntingEthics/ethics_cannedshoot.asp?area=huntingEthics, accessed August 2011).

Conservation issues arising from the captive-bred lion hunting industry include the probability that the genetics of captive animals are being manipulated, potential impacts on demand for the bones of wild felids, and potential impacts on the demand for wild lion hunts. If there are any future efforts to control the captive-bred lion hunting industry, decision-makers should take cognisance of the potential for increased demand for wild lion trophies and implement steps to prevent excessive harvests. Such steps should include tight restrictions on sustainable harvests, age restrictions on lion trophies, and in South Africa, consideration of implementing buffer zones around parks in which lion hunting is prohibited or strictly controlled. Further research is urgently required into the issue of the trade of lion bones from South Africa to identify the potential risks and issues for lion conservation.

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