Trophy hunting, size, rarity and willingness to pay: inter–specific analyses of trophy prices require reliable specific data

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Abstract

Trophy hunting, size, rarity and willingness to pay: inter–specific analyses of trophy prices require reliable specific data.— Awareness of the importance of the wildlife trade and human perception in animal conservation is growing. Recent studies carried out on a continental and world scale have analysed the associations between trophy score, rarity and prices. As a large range of ungulates are legally hunted throughout the world and numerous ungulate taxa are threatened, the relationship between rarity and trophy prices has been studied in several species. This article briefly reviews verifiable data on species and trophy prices and compares findings with data used in recent articles. The findings show that several elements of intra–specific data were inadequately addressed and that the trophy prices considered were not necessarily representative of real trophy prices. Furthermore, the body mass used for numerous taxa did not fit current knowledge of species, and several subspecies and rarity indexes that were considered disagreed with recognized subspecies or with the real conservation status of taxa. Thus, caution should be taken when considering some reported results. To improve our understanding of the associations between wildlife trade and wildlife conservation, further studies should take into account reliable specific data, such as that from government agencies, rather than publicity data.

Key words: Ungulate, Recreational hunting, Trophy price, Game management, Wildlife trade.

Resumen

La caza de trofeos, el tamaño, la rareza y la disposición a pagar: los análisis interespecíficos de los precios de los trofeos requieren datos específicos fiables.— Cada día hay más conciencia de la importancia que tienen el comercio de fauna silvestre y la percepción de los animales por parte del hombre en la conservación de los mismos. En determinados estudios llevados a cabo recientemente a escala continental o mundial se han analizado las relaciones existentes entre la puntuación de los trofeos, la rareza y los precios. Numerosas especies de ungulados se cazan legalmente en todo el mundo y varias de ellas son especies amenazadas. Por este motivo, se ha estudiado la relación existente entre la rareza y los precios de los trofeos en varias especies. En el presente artículo se examinan brevemente los datos verificables relativos a las especies y los precios de los trofeos, y se comparan con los datos utilizados en algunos artículos recientes. Los resultados ponen de manifiesto que varios elementos de los datos intraespecíficos se trataron inadecuadamente y que los precios de los trofeos analizados no eran necesariamente representativos de los precios reales. Asimismo, el peso corporal utilizado para muchos ungulados no se ajustaba a los valores documentados para estas especies y varias de las subespecies así como algunos indicadores de rareza analizados no se correspondían con las subespecies reconocidas o con su estado real de conservación. Por consiguiente, los resultados documentados deberían ser considerados con cautela. Para comprender mejor las relaciones existentes entre el comercio y la conservación de la fauna silvestre, los futuros estudios deberían tener en cuenta información específica fiable, por ejemplo de organismos gubernamentales, en vez de información publicitaria.

Palabras clave: Ungulados, Caza recreativa, Precio de trofeo, Gestión cinegética, Comercio de fauna silvestre.

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Introduction

Public awareness of the wildlife trade is increasing and understanding the need for animal conservation is growing (Johnson et al., 2010; Sarasa et al., 2012a). Human perception of species modulates wildlife conservation, and wildlife conservation policies affect human perception of species. Both international and local perception of wildlife may affect environmental policy and management practices (Pusey et al., 2007; Li et al., 2010). However, the perceived rarity of species and even policy and legal frameworks that compile the conservation status of species and that regulate the trading of wild animals —such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the International Union for the Conservation of Nature (IUCN)— may themselves increase trading activity because of a 'Limited edition' effect on wildlife trade (Barnes, 1996; Slone et al., 1997; Raymakers, 2002; Stuart et al., 2006). The 'limited edition' effect might be defined as an increase in desire for goods because they are limited in number or supply. The 'limited edition' effect has been a key tool in marketing management for decades (Mazis et al., 1973; West, 1975; Worchel et al., 1975; Balachander & Stock, 2008) and in wildlife trade in recent years it has been called the anthropogenic Allee effect (Courchamp et al., 2006). The 'limited edition' concept carries a sense of immediacy and exclusivity of goods which will only be available for a short time and/or in limited numbers. The concept affects the perceived rarity; it favours stiff prices and benefits and it stimulates impulsive purchases and collector behaviours (Mazis et al., 1973; West, 1975; Worchel et al., 1975; Balachander & Stock, 2008). Exploited rare goods or species, might become even rarer and thus more valuable, sucking them into a vortex toward the extinction of populations or species. This phenomenon might affect, for instance, insects, bird eggs, hunting trophies, and even live animals (Slone et al., 1997; Kiff, 2005; Courchamp et al., 2006; Stuart et al., 2006). The 'limited edition' effect in wildlife trade and conservation has received increasing interest over the last decade. As previously observed in collected insects (Slone et al., 1997), Johnson et al. (2010) highlighted the relationships between trophy score, rarity and prices of 159 taxa hunted in Africa. Palazy et al. (2012) later carried out a world scale analysis of these associations in trophy ungulates. Their compiled data were presented in an Appendix file that provides the opportunity to verify the reliability of such analysis. In this article I briefly reviewed verifiable data on species and trophy prices to compare these to the data detailed in the Appendix file of Palazy et al. (2012). The operational sections of this review are mainly focused on the data set of Palazy et al. (2012), although other studies based on undetailed publicity data from commercial hunting companies (Courchamp et al., 2006; Johnson et al., 2010; Palazy et al., 2011; Prescott et al., 2012) are probably affected by this issue to some extent.

Misrepresented data

Palazy et al. (2012) attempted to cover a larger range of taxa than previous studies, but several elements of intra–specific data noted thereafter were not adequately addressed. To compare trophy prices between species (see table 1 for detailed presentation of trophy price indexes), Palazy et al. (2012) used annual trophy prices from hunting companies, assuming that governments fix trophy fees and that trophy prices from hunting companies are representative of trophy fees and of the perceived value of trophies. However, this is not necessarily the case because, as detailed in table 1, trophy price is calculated using different formulas, and trophy fee is just one factor of the factors taken into account.

Auction hammer prices, complementary prices and profits of hunting companies cause substantial differences between trophy fees and trophy prices. Moreover, in several countries, for instance in Spain, local hunters, national hunters and international hunters may use different formulas to calculate trophy prices. For instance, Palazy et al. (2012) used a trophy price of USD 7,800 for both subspecies of the Iberian ibex *Capra pyrenaica,* Schinz 1838. Nevertheless, *C. p. victoriae,* Cabrera 1911, generally has longer and thicker horns than *C. p. hispanica,* Schimper 1848 (Granados et al., 2001) and so is often more appreciated by hunters and more expensive. Hunting permits for trophies are usually increased for auction (starting price in 2008: USD 6,635 at Riaño for *C. p. victoriae*; USD 3,650 in Andalucía for *C. p. hispanica*) and the perceived value of trophies, that is, their final sale price, consists of the hammer price plus a complementary price depending on the trophy score (Diario de León.es, 2008c; Junta de Andalucía, 2008) (tables 1, 2). The volatility of demand is hence a major factor in trophy prices. At Riaño, a record hammer price reached USD 39,870 in 2012, leading to a final price of USD 89,625 because of the score–based complementary price that reached USD 49,755 (Diario de León.es, 2012). According to table A1 of Palazy et al. (2012), only trophies of Markhor *Capra falconeri,* Wagner 1839, and of rhinoceros species would be more expensive than this trophy of Iberian ibex. However, this suggests trophy prices are misrepresented in their data set. The Iberian ibex is not an isolated case and table 2 highlights that numerous other species are also affected by this issue. Mismatches between trophy prices used by Palazy et al. (2012) and true trophy prices were also recorded within and between other species (table 2). In 23 taxa with verifiable data, only two presented absolute mismatches lower than 10% (mean; min; max: 35%; –140%; 92%). For instance, the prices of Iberian ungulates were over– or under–estimated, and the reported price differences between species from Europe, Asia or Africa mismatch the true differences between trophy fees reported by several authors (table 2). Thus, the prices used by Palazy et al. (2012) —probably distorted by call prices and by exaggerated prices of hunting companies (table 1)— are not representative of real trophy prices. Festa–Bianchet (2012) already suggested that

Table 1. Definitions of trophy price indexes.

Tabla 1. Definiciones de los índices de precios de los trofeos.

Trophy fees (TF)	Fixed amount of money paid to the management institution (*e.g.* governments or parks) for hunting one trophy individual.
Starting price for auction (SPA)	Initial amount of money expected by a management institution that sells by auction trophy hunting individuals.
Auction hammer price (AHP)	Final amount of money proposed by a purchaser to a management institution that sells by auction trophy hunting individuals. Auction hammer price is higher than the starting price for auction when the demand is greater that the supply.
Trophy score (TS)	Numerical value attributed to trophies according to measurements and appreciations (*e.g.* length, thickness, complexity, preferred shape, deformities, etc.) based on referenced hunters' aesthetic preferences.
Complementary price depending on the trophy score (CP)	Additional cost that can be fixed on the basis on the hunting trophy score of the individual hunted in the field. This additional cost is particularly common when the exact trophy value of individuals is estimable with difficulty from a distance or to apply penalties to mismatches between agreed hunting permits and observed hunting events.
Profit of hunting companies (PHC)	Difference between the fees paid to management institutions by hunting companies and the fees paid by hunters to the latter for hunting trophy individuals.
Call prices of hunting companies (CPHC)	Marketing tool of companies that can present underestimated trophy prices in their advertising to attract potential customers. Once obtained, the customer's interest and confidence allows commercial profits to be derived from overblown complementary costs.
Exaggerated prices of hunting companies (EPHC)	Commercial tool that can be used by companies to increase their commercial profits by using overblown price of their hunting permits. EPHC are largely due to scarcity of information about sales of hunting permits and on management institutions' trophy fees.
Trophy price (TP) or final sale price	Amount of money paid by hunters for hunting one trophy individual. It reveals the perceived trophy values. When hunters directly pay management institutions that apply fixed trophy prices: TP = TF or TP = TF + CP When hunters directly pay management institutions that sell by auction trophy hunting individuals: TP = AHP or TP = AHP + CP When hunters pay for trophy hunting through hunting companies: TP = TF + PHC or TP = TF + CP + PHC or TP = AHP +PHC or TP = AHP + CP + PHC

marketing may have a stronger effect than rarity on the cost of a hunt with hunting operators, although the two concepts are sometimes linked to each other. Price mismatches could be a serious concern in Palazy et al.'s analyses and interpretations, particularly taking into account that hunting companies just represent a variable, and often a minority part, of the total trophy hunting activity (Sharp & Wollscheid, 2009). This critical reappraisal was possible in Palazy et al.'s study because they presented a detailed data set.

Table 2. Mismatches between available specific data and data used in Palazy et al. (2012) (*): [1] Starting price for auction. [2] Auction hammer price. [3] Fee paid to the management institution for one individual. [4] The distinction between West Siberian Moose *A. a. pfizenmayeri* and East Siberian moose *A. a. buturlini* has not been widely accepted; body mass presented for *A. a. pfizenmayeri* (Rodgers, 2001). [5] Alashan wapiti *C. e. alashanicus* and Gansu deer *C. e. kansuensis* are considered as synonyms by Dolan (1988) and Groves (2006) recommended that the recognition of these taxa should be left for further studies; body mass presented for *C. e. kansuensis.* [6] The valid name of this species is *Damaliscus pygargus*, not *Damaliscus dorcas*; the two well–differentiated subspecies are the Bontebok *D. p. pygargus* and the Blesbok *D. p. phillipsi* (Lloyd & David, 2008). [7] Unclear taxonomic position; *S. c. brachyceros* would include planiceros (Van Hooft et al., 2002). [8] It is still unclear whether *C. caucasica* and *C. cylindricornis* are two separate species or if they are a single species with geographically dependent variability (Weinberg, 2008); Mid–Caucasian tur is considered a potential hybrid of *C. caucasica* and *C. cylindricornis* (Kopaliani & Gurielidze, 2009). [9] The taxonomy of *Capra sibirica* subspecies is not yet resolved and *C. s. hemalayanus* is not a recognized subspecies (Reading & Shank, 2008). [10] Two subspecies are recognized: Defassa Waterbuck *K. e. defassa* and Ellipsen Waterbuck *K. e. ellipsiprymnus*; *K. e. crawshayi* is included in *K. e. ellipsiprymnus* and *K. e. unctuosus* is included *K. e. defassa* (IUCN SSC Antelope Specialist Group, 2008; Lorenzen et al., 2006). [11] Argali *O. a. ammon* and *darwini* could be considered a single ESU or subspecies (Tserenbataa et al., 2004). [12] Three subspecies are recognized and *T. s. bea* is included in *T. s. strepsiceros* (Kingdon, 1997; Nersting & Arctander, 2001). [13] Three subspecies are recognized and *T. s. burlacei* is *T. s. cottoni* (Nersting & Arctander, 2001). [14] The two last records of the table A1 in Palazy et al. (2012) referred to *T. s. strepsiceros* and can not be considered rigorously as different tax.

Tabla 2. Diferencias entre los datos específicos disponibles y los datos utilizados en Palazy et al. (2012) (*): [1] Precio de salida para la subasta. [2] Precio de remate de la subasta. [3] Tasa pagada a la institución encargada de la gestión por un individuo. [4] La distinción entre el alce de Yakutia A. a. pfizenmayeri *y el alce de Kamchatka* A. a. buturlini *aún no se ha aceptado ampliamente; peso corporal presentado para* A. a. pfizenmayeri *(Rodgers, 2001). [5] El uapití de Alashan* C. e. alashanicus *y el ciervo Gansu* C. e. kansuensis *se consideran sinónimos en Dolan (1988) y Groves (2006) recomendó que el reconocimiento de estos taxones se dejara para estudios posteriores; peso corporal presentado para* C. e. kansuensis*. [6] El nombre válido de esta especie es* Damaliscus pygargus*, no* Damaliscus dorcas*; las dos subespecies bien diferenciadas son el bontebok* D. p. pygargus *y el blesbok* D. p. phillipsi *(Lloyd & David, 2008). [7] Posición taxonómica poco clara;* S. c. brachyceros *incluiría a los búfalos del grupo* S. c. planiceros *(Van Hooft et al., 2002). [8] Aún no está claro si* C. caucasica *y* C. cylindricornis *son dos especies distintas o una sola con variabilidad geográfica (Weinberg, 2008); el tur del Cáucaso central se considera un posible híbrido de* C. caucasica *y* C. cylindricornis *(Kopaliani & Gurielidze, 2009). [9] La taxonomía de las subespecies de* Capra sibirica *aún no se ha resuelto y* C. s. hemalayanus *no es una subespecie reconocida (Reading & Shank, 2008). [10] Se reconocen dos subespecies: el antílope defasa* K. e. defassa *y el antílope acuático de Ellipsen* K. e. ellipsiprymnus*;* K. e. crawshayi *se incluye en* K. e ellipsiprymnus *y* K. e. unctuosus *se incluye en* K. e. defassa *(Grupo de especialistas sobre el antílope de la Comisión de Supervivencia de Especies de la Unión Internacional para la Conservación de la Naturaleza, 2008; Lorenzen et al., 2006). [11] Los muflones de Argal* O. a. ammon *y* O. a darwini *podrían considerarse una única UES o subespecie (Tserenbataa et al., 2004). [12] Se reconocen tres subespecies y* T. s. bea *se incluye en* T. s. strepsiceros *(Kingdon, 1997; Nersting & Arctander, 2001). [13] Se reconocen tres subespecies y* T. s. burlacei *se incluye en* T. s. cottoni *(Nersting & Arctander, 2001). [14] Los dos últimos registros de la tabla 1 en Palazy et al. (2012) hacen referencia a* T. s. strepsiceros *y no pueden considerarse rigurosamente como taxones distintos.*

Trophy price

Species

Subspecies (in table A1) (*)	Record (in table A1) (*)	Trophy price (in USD) (*)	Trophy price index (in USD)	Reference
Capra pyrenaica				
C. p. hispanica	34th	7,800	3,650[1]	(Junta de Andalucía, 2008)
C. p. victoriae	35th	7,800	6,635[1]	(Diario de León.es, 2008c)
C. p. victoriae	35th	7,800	17,120–20,300[2]	(Diario de León.es, 2008b)
Rupicapra pyrenaica				
R. p. parva	168th	4,900	2,654[1]	(Diario de León.es, 2008c)
R. p. parva	168th	4,900	4,378–4,436[2]	(Diario de León.es, 2008a)
R. p. pyrenaica	169th	4,900	4,237–4,767[2]	(Heraldo.es, 2008)

Table 2. (Cont.)

Species	Subspecies (in table A1) (*)	Record (in table A1) (*)	Trophy price (in USD) (*)	Trophy price index (in USD)	Reference
Cervus elaphus					
	C. e. hispanicus	58th	4,500	1,990[1]	(Diario de León.es, 2008c)
	C. e. hispanicus	58th	4,500	3,509[2]	(Diario de León.es, 2008a)
Capreolus capreolus		40th	2,216	1,327[1]	(Diario de León.es, 2008c)
		40th	2,216	1,768[2]	(Diario de León.es, 2008a)
Capra falconeri					
	C. f. falconeri	32th	70,000		
	C. f. jerdoni			20,000–35,000[3]	(Frisina & Tareen, 2009)
Ovis vignei					
	O. v. cycloceros	144th	8,000	6,500–11,000[3]	(Frisina & Tareen, 2009)
Diceros bicornis		77th	150,000	195,000–210,000[3]	(Davies et al., 2009)
Syncerus caffer					
	S. c. caffer	176th	7408	600[3]	(Lamprey & Mugisha, 2009)
Potamochoerus porcus		148th	632	150[3]	(Lamprey & Mugisha, 2009)
Taurotragus oryx					
	T. o. pattersonianus	182th	2125	500[3]	(Lamprey & Mugisha, 2009)
Hippopotamus amphibious		87th	2328	500[3]	(Lamprey & Mugisha, 2009)
Aepyceros melampus					
	A. m. rendilis	3rd	663	250[3]	(Lamprey & Mugisha, 2009)
Ourebia ourebia		119th	645	150[3]	(Lamprey & Mugisha, 2009)
Redunca redunca					
	R. r. wardi	163th	605	250[3]	(Lamprey & Mugisha, 2009)
Damaliscus lunatus					
	D. l. jimela	73th	910	350[3]	(Lamprey & Mugisha, 2009)
Phacochoerus aethiopicus		146th	454	250[3]	(Lamprey & Mugisha, 2009)
Kobus ellipsiprymnus					
	K. e. defassa	94th	676	500[3]	(Lamprey & Mugisha, 2009)

Body mass

Species	Subspecies (in table A1) (*)	Record (in table A1) (*)	Male body mass (*)	Male body mass	Reference
Alces alces					
	A. a. alces	9th	400	375–475	
	A. a. cameloides	12th	453.5	250–350	(Bishop, 1988; Haigh et al., 1980; Rodgers, 2001; Wallin et al., 1996)
	A. a. buturlini [4]	11th	453.5	340–6,554	
	A. a. andersoni	10th	453.5	350–570	
	A. a. gigas	13th	453.5	400–700	

Table 2. (Cont.)

Species: Subspecies (in table A1) (*)	Record (in table A1) (*)	Male body mass (*)	Male body mass	Reference
Capra pyrenaica				
C. p. hispanica	34th	72.5	50.4–65	(Couturier, 1962; Granados et al., 2001)
C. p. victoriae	35th	72.5	61.9–90	
Ceratotherium simum				
C. s. cottoni	53th	2800	100–1,600	(Groves et al., 2010)
C. s. simum	54th	2800	2,000–2,400	
Cervus elaphus				
C. e. alashanicus [5]	56th	180.5	2405	http://www.scirecordbook.org/gansu–deer/
C. e. hippelaphus	57th	180.5	160	(Geist & Bayer, 1988)
C. e. hispanicus	58th	180.5	80–160	(Carranza, 2011)
C. e. kansuensis[5]	59th	180.5	2,405	http://www.scirecordbook.org/gansu–deer/
C. e. nelsoni	60th	180.5	350	(Geist & Bayer, 1988)
C. e. sibiricus	61th	180.5	300	http://www.scirecordbook.org/altai–wapiti/
C. e. songaricus	62th	180.5	300	(Gao et al., 2011)
Cervus nippon	63th	47.6	30–120	(Groves, 2006)
Damaliscus dorcas [6]				
D. d. dorcas [6]	71th	68	46.5	(Hayward et al., 2006)
D. d. phillipsi [6]	72th	68	52.5	
Syncerus caffer				
S. c. aequinoctialis	174th	522	500–590	(Hayward et al., 2006; Solounias et al., 1994)
S. c. brachyceros	175th	522	400–500	http://www.scirecordbook.org/nile–buffalo/
S. c. caffer	176th	522	432–754	http://www.scirecordbook.org/central–african–savanna–buffalo/
S. c. nanus	177th	522	265	
S. c. planiceros [7]	178th	522	320–410	http://www.scirecordbook.org/west–african–savanna–buffalo

Conservation status

Species: Subspecies (in table A1) (*)	Record (in table A1) (*)	Conservation status (*)	Proposed conservation status	Reference
Capra pyrenaica				
C. p. hispanica	34th	Least concern	Least concern	(Acevedo & Cassinello, 2009; Pérez et al., 2002)
C. p. victoriae	35th	Least concern	Vulnerable	
Naemorhedus goral	112th	Near threatened	Endangered	(CITES, 2011)
Ovis ammon				
O. a. hodgsoni	127th	Near threatened	Endangered	(CITES, 2011)
O. a. polli	130th	Near threatened	Vulnerable	(Schaller & Kang, 2008)

Table 2. (Cont.)

Other unclear or unrecognized taxonomic distinctions

Species	Subspecies in table A1 (*)	Record in table A1 (*)
Capra cylindricornis [8]		31th
Capra caucasica [8]	*C. c. caucasica* [8]	29th
	C. c. dinniki [8]	30th
Capra sibirica	*C. s. hemalayanus* [9]	38th
Kobus ellipsiprymnus	*K. e. crawshayi* [10]	93th
	K. e. defassa [10]	94th
	K. e. ellipsiprymnus [10]	95th
	K. e. unctuosus [10]	96th
Ovis ammon	*O. a. ammon* [11]	123th
	O. a. darwini [11]	126th
Tragelaphus strepsiceros	*T. s. bea* [12]	198th
	T. s. burlacei [13]	199th
	T. s. chora	200th
	T. s. strepsiceros [14]	201th
	T. s. strepsiceros [14]	202th

However, other studies that used trophy prices from hunting companies (Courchamp et al., 2006; Johnson et al., 2010; Palazy et al., 2011) were exposed to this concern as well. The variability of trophy price setting systems between countries and taxa is a key factor of this question. Thus, to promote the reliability of results, a detailed presentation of trophy prices and of setting systems should be required for each record and taken into account. Further studies should consider trophy prices from governmental agencies rather than publicity data to improve the accuracy of row data, of results and of biological inferences.

By separating sub–species, Palazy et al. (2012) were able to address a large range of taxa. Beyond unclear and unrecognized taxonomic distinctions (table 2), the 'subspecies' of 34 species (103 units in all) were considered as having a single mean body mass (BM) per species, but the subspecies of other taxa were considered to have different BM. Differences in BM were probably considered when found. However, in the Iberian ibex, *C. p. hispanica* is known to be smaller than *C. p. victoriae* (Couturier, 1962; Fandos & Vigal, 1988; Granados et al., 1997; Granados et al., 2001). Similarly, among other species, Alaska moose *Alces alces gigas,* Miller 1899, is the heaviest subspecies of moose (Flerov, 1952; Peterson, 1955; Bishop, 1988) and subspecies of *Cervus elaphus,* Linnaeus 1758, differ in size (Lowe & Gardiner, 1989; Haigh & Hudson, 1993; Novak, 1999), but this was not taken into account (table 2). The data of Palazy et al. (2012) on BM are not representative of the 202 ungulate units used and as such their results would have been artificially smoothed. Of the 24 taxa with verifiable data, only five presented absolute mismatches lower than 10% (mean; min; max: –4%; –94%; 49%). These observed errors in BM cannot be due to consistent methodology because, as highlighted in the several examples (table 2), data on subspecies body mass are already available in the scientific literature in common data bases on the Internet (http://wokinfo.com; http://scholar.google.com; etc.). Thus, further studies could detail the references for BM to encourage the use of reliable data.

Hunting institution databases record the trophies that have been harvested over long periods of time (see, for instance, Monteith et al., 2013). However, trophy scores are estimated on the basis of the global biometry of the horns and the aesthetic preferences of hunters to compare trophies within a species. They do not therefore accurately take into account confounding factors such as the age of the animal. Trophy scores do not adequately reflect real horn size, at least in wild sheep (König & Hoefs, 1984), just as classical measurements of animal weapons are not necessarily representative of true horn growth (Sarasa et al., 2012b). Wild sheep represents 11% of the sample in Palazy et al. (2012) and most of their sample consists of horned ungulates. This is also a

major concern of the biological inferences derived from interspecific analysis of trophy score data. Courchamp et al. (2006) assumed that trophy scores allow interspecific comparisons but the reliability of this factor as a proxy for interspecific comparisons of trophy size is an issue that is still somewhat open. Confusion between trophy score and trophy size might not have affected the analyses *per se*. However, this questionable proxy favours confusion between two different concepts and it leads to an overblown perception of the biological reliability of trophy scores and of the inferences derived from these studies. Thus, the limitations of trophy scores as a proxy of trophy size should have been commented and mentions of trophy size should be avoided when referring to trophy score. Other studies that used trophy scores (Johnson et al., 2010; Palazy et al., 2011) were exposed to this concern as well.

Palazy et al. (2012) used IUCN categories as a proxy of rarity. IUCN statuses are interesting proxies of the conservation status for a focal species at the temporal scale of decades. The long temporal scale of IUCN status is due to the definition of threatened status. It is often based on the restricted size of populations and/or on population reductions over the last 10 years or three generations. As a result, IUCN status is a relative index of conservation status for each species, but not an absolute conservation index. IUCN categories may be intrinsically vague and are a problem for those trying to classify species (Regan et al., 2000). Thus, IUCN statuses are not an accurate source of information for inter–specific analyses. Assuming that IUCN statuses might be considered as accurate proxies of the human perception of the rarity of species, other problems remain. Palazy et al. (2012) considered subspecies to increase their sample size while conservation status of most subspecies is not detailed in the IUCN red list. Mismatches were also observed. Several mismatches in rarity values probably resulted from partial and incomplete updating of IUCN pages and of the overblown sample size in Palazy et al.'s study. For instance, both subspecies of Iberian ibex were considered to be of 'Least Concern' by Palazy et al. (2012). However, *C. p. victoriae* is classified as 'Vulnerable' since it only inhabits a few, small areas, while *C. p. hispanica* is of 'Least Concern' where its viability depends on ongoing conservation programmes (Pérez et al., 2002; Acevedo & Cassinello, 2009). *Ovis ammon polii,* Blyth 1841, is considered to be 'Near Threatened' by Palazy et al. (2012), but a status of 'Vulnerable' seems more accurate (Schaller & Kang, 2008). Thus, to remedy IUCN red list updating limits, specific scientific literature should be assessed in detail and researchers specialized in focal species should be contacted to avoid using incomplete and unrepresentative data. Specialists of focal species have updated knowledge of the conservation status and of the actual perceived rarity of species; well–informed dwellers/hunters sometimes forestall potential changes in conservation status by policy and legal frameworks (Rivalan et al., 2007). In Palazy et al. (2012), 81 subspecies of 25 species were considered to have a single conservation status per species and the proxies of rarity are not necessarily representative of the real conservation status of the 202 considered records (table 1).

Conclusion

A critical question in inter–specific studies is that unreliable data should be discarded as much as possible because it produces unreliable results. Study designs should be adjusted to ensure the best resolution in sampling while preserving the reliability of the data. In Palazy et al.'s study, taking into account that many data represent species but not subspecies, analysis of the 112 considered species rather than 202 questionable taxa may have been less overblown. The results of Palazy et al. (2012) are potentially interesting because they converge with those of Johnson et al. (2010). Nevertheless, as in other articles on the subject, in Palazy et al. (2012) several elements of intra–specific data were not properly addressed in at least 25–35% of the sample [25% if we only take into account mismatches in trophy prices, body mass, IUCN status and unclear or unrecognized taxonomic distinctions; 35% if we also take into account that classical measurements of weapons and trophy scores misrepresent trophy size (König & Hoefs, 1984; Sarasa et al., 2012b)]. Thus, caution should be taken when considering the reported results. Moreover, while tourist/ foreign hunters spend far more per head than non–tourist/local hunters, international trophy hunting with commercial hunting operators is associated with a global total in spending that is much less than that of stay–at–home hunters (Sharp & Wollscheid, 2009). The economics of commercial hunting operators is a minor part of the total economics of hunting (Sharp & Wollscheid, 2009). This should be also taken into account to avoid overestimating the scientific importance of analysis of publicity data from commercial hunting companies compared to the total economics of hunting. To some extent, other studies that were based on undetailed publicity data from commercial hunting companies (Courchamp et al., 2006; Johnson et al., 2010; Palazy et al., 2011; Prescott et al., 2012) are probably affected by this issue. Biological data and economic data should be adequately addressed in future studies. These should prefer representative lists of trophy prices from governmental agencies rather than publicity data; systematics, body mass, and rarity indexes should be properly represented when data are already available; trophy size should be properly characterized, avoiding aesthetic and incomplete proxies such as trophy score and horn length alone. A rigorous compilation of row data is required so that high quality studies may support the understanding of wildlife trade and the conservation of threatened species.

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