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COMMENTARY

Trophy hunting with uncertain role for population dynamics and extinction of ungulates

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Many species of large mammals are threatened. Overexploitation is involved as a driver for population declines in many cases, and understanding the mechanisms provides a key to mitigative efforts. The population dynamic effects of harvesting vary considerably not only due to differences in hunting pressure, but also due to variable selectivity. Hunters aiming for meat, recreation, trophies or population control will target different kind of individuals (Mysterud, 2011), and different sex and age classes have largely variable contribution to population growth. Understanding the motivation for harvest is thus a key point, and the study by Palazy *et al*. (2012) is a major step forward to understand what is the motivation of trophy hunters at the interspecific level.

Palazy *et al*. (2012) analyse a huge dataset on trophy fees of 427 ungulate species. The important insight yielded is how pricing of trophies varies as a function of animal traits, both morphological and in terms of rarity. The analysis is sophisticated, so there is no reason to doubt the patterns reported. Palazy *et al*. (2012) further suggest that trophy hunters' attraction for rarity could lead to an 'overexploitation chain reaction', being a mechanism for an anthropogenic Allee effect (AAE). This claim appears more speculative. Palazy *et al*. (2012) claim that 'Globally, trophy hunting has been shown to be detrimental to several species'. However, the three references provided give no clear evidence that ungulates in general are negatively affected by trophy hunting. For example, one case is the brown bear (*Ursus arctos*) from Scandinavia documenting that removal of a dominant male represent a risk of increased infanticide by immigrating males (Swenson *et al*., 1997). However, this is not typical trophy hunting, as the hunters are not selective (Bischof *et al*., 2009). Even with this infanticide mechanism present, this brown bear population has among the highest growth rates recorded worldwide, suggesting sustainable harvesting.

When is trophy harvesting likely to cause an AAE? Key questions for the argument of AAE is what demographic class of animal is the target of hunting, what is the mating system and what happens to the conception of a trophy when animals get rare.

(1) In general, prime-aged males from the most sexually dimorphic species appear the typical target of trophy hunting. There is a clear link between large sexual body size dimorphism, male size and the level of polygyny in ungulates (Loison *et al*., 1999). With high levels of polygyny, male-biased harvesting must be intense before females are not inseminated, and often younger males take over as sires (Mysterud, Coulson & Stenseth, 2002). Indeed, despite extremely skewed sex ratios in many populations of deer, the main problems are often those related to overabundance (McShea & Underwood, 1997). The single documented case in which a skew in sex ratio has caused severe population decline is for the saiga antelope (*Saiga tataricus*), when the proportion of adult males reached < 2% of the population (Milner-Gulland *et al*., 2003). For saiga, medicinal use was the main motivation for hunting, not trophies. One may also argue that trophy hunters target the most viable males, but the link between survival and trophy size is weak at best (Bonenfant *et al*., 2009). We would, however, expect stronger effects of harvesting males in general for monogamous species (Parker, Rosell & Mysterud, 2007). These species, however, have lower trophy prices in ungulates (Palazy *et al*., 2012).

(2) Females may be a target for trophy hunters if sexual body size dimorphism is small or other secondary sexual characters are absent, this will largely increase the population dynamic effect of trophy hunting. For Bovids, for example in oryx (*Oryx gazella*) and eland (*Taurotragus oryx*), female horns are often also valued by trophy hunters being longer (though thinner) than male horns. Indeed, the best case of unsustainable sport hunting reported by Caro *et al*. (1998) was for eland. If trophy hunting was driving extinction in cases where females possess horns, we would expect a different effect in Cervids and Bovids, as female Cervids do not possess antlers (apart from reindeer). Palazy *et al*. (2012) report no difference in pricing between Cervids and Bovids, and pricing increased rather than decreased

with male size. However, such factors may explain why the two case studies of detrimental trophy hunting come from carnivores having less marked sexual dimorphism and often a different mating system (Caro *et al*., 1998; Packer *et al*., 2011).

(3) Lastly, trophy hunting could cause an AAE if trophy hunters stop being picky on size (or sex) when animals get rare, if *any* trophy will increase in value for rare species. If so, the following can be predicted: for rare species, within species variance in trophy pricing is small ('any trophy from a rare species would do'). For common species, variance in trophy pricing is high ('extreme value to the largest'), as there is much to choose from, and because all trophy hunters know the scale – realizing this one is a big individual.

Clearly, Palazy *et al*. (2012) provide one major step forward in understanding pricing of trophies among species. Hopefully, they will continue their important work to understand the variation of prices also within species, and to provide explicit links to population dynamics.

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