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Comment

The cashmere connection, biodiversity, and climate: response to von Wehrden et al. 2014

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Introduction

Domestic and feral goats support human livelihoods and affect ecosystems. In arid regions of Asia, the governments of both China and Mongolia recognize the massive ecological changes associated with livestock (Lia et al. 2000; Harris 2010), yet little specific information exists about effects of goats on wildlife. Berger et al. (2013) draw attention to the global trade in cashmere, a valued goat fiber, as an external driver of regional biodiversity. In addition to a concentration on ecological interactions (fig. 1 and table 1 in Berger et al. 2013), we suggest that components of central Asian biodiversity cannot be successfully conserved until diverse modifiers of ecosystems—such as people, economies, historical events, and culture—are better understood. We concluded by suggesting that a dialogue among pastoralists, governments, the fabric industry, and conservationists would be the first step toward assuring wildlife better future prospects while sustaining pastoralist livelihoods.

Von Wehrden et al. (2015) agree with our report of rising goat numbers but challenge the idea that the cashmere trade is an important driver of this increase. But, they offer no alternative reasons for the proportionally greater increase in goats relative to other livestock. Instead, they suggest that we oversimplified or missed the complex nature of nonequilibrium dynamics, basing their critique on a subregion within our study area. Von Wehrden et al. omit substantive points in their attention to ecological nuance and cavils about missing data. And, their restricted spatial and thematic focus bypasses opportunities to learn from larger areas of arid and cold Chinese and Indian sites, where similar precipitation patterns challenge herders who also make their livings selling cashmere.

Our paper was not about nonequilibrium dynamics per se, although these are of interest. We focused on the varied impacts of livestock on biodiversity across our 3-country study region. Here, we reiterate how the cashmere market is central to the trend of increasing goat populations in many parts of Central Asia and, therefore, is of concern for those who wish to conserve biodiversity while safeguarding the welfare of pastoralist communities. We are mindful of the central mission of the Society of Conservation Biology—"advancing the science and practice of conserving Earth's biological diversity."

We believe the von Wehrden et al. (2015) comment is misguided in 3 key areas: its failure to move beyond the science of ecology by concentrating on climate as the ultimate driver of goats (Fig. 1); its omission of the biocomplexity of the system, especially the nature of direct and indirect interactions; and its biased use of the literature to inappropriately refute our points.

Climate as a Central Driver

Regulation of livestock numbers by strong winter storms (*dzuds* in Mongolian) and by progressively larger populations of domestic species is not surprising. To simply claim, however, that independent weather events decrease populations without additional detail ignores a vast literature about competitive interactions between livestock and native species; overlooks the role of density-dependent feedback effects on body condition, reproduction, and survival regardless of aridity; and does not preclude negative effects of livestock on wildlife.

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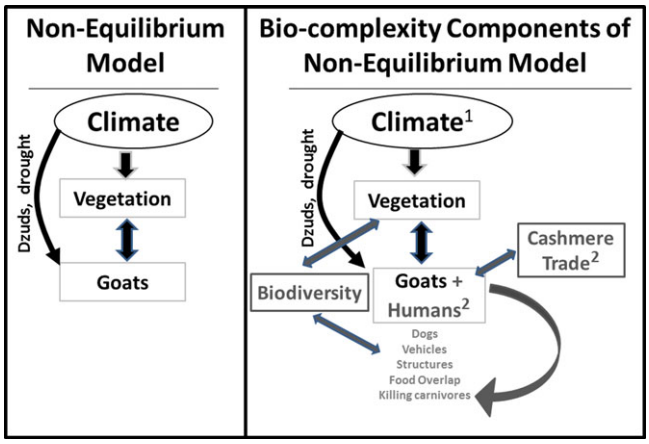

Figure 1. Schematic outline of nonequilibrium model of the livestock grazing system in Central Asia as suggested by von Wehrden et al. (2015) (left) compared with a model that incorporates biocomplexity components (gray) including (1) direct and (2) indirect (as prompted through humans) external drivers to illustrate connections to biodiversity and cashmere trade (right). Effects of dzuds (i.e., intense winter storms) and drought on biodiversity are poorly known, although dzuds kill a disproportionate number of livestock.

The relevant question is whether wildlife can persist under conditions of extremely high livestock density. In Mongolia and other areas of Central Asia, livestock in winter are fed supplementally and provided with veterinary care and shelter. Wildlife is not and should therefore be expected to suffer more from overgrazing than livestock. Consequently, wildlife may respond negatively to livestock density before livestock do.

With respect to ungulate densities, it is curious that von Wehrden et al. ignore large asymmetries in the ratio of domestic to native species (approximately 19:1) (Berger et al. 2013) across our study regions. We believe it is unreasonable not to expect grazing pressures alone (see Fig. 1) to substantially reduce available plant matter. For saiga (*Saiga tatarica*), argali (*Ovis ammon*), and blue sheep (*Pseudois nayaur*), diet overlap with domestic species is high (Mishra et al. 2004; Buuveibaatar et al. 2011; Wingard et al. 2011), a situation that leads to forage competition (Mishra et al. 2004). Instead, von Wehrden et al. offer a simple argument that deserts are variable and inclement weather decreases populations of all species.

Biocomplexity

Von Wehrden et al.'s focus on climate and nonequilibrium dynamics is off target of one of our central points: incentives from distant markets affect local biodiversity. We believe fig. 1 in Berger et al. (2013) captures the essence of supply chain and trophic interaction complexities underlying this socioecological system. There are fundamental differences between what von Wehrden et al. suggest as a critical point and our view of the main intersections among core elements—cashmere trade, climate, and biodiversity (Fig. 1). Of relevance, as previously noted, is a suite of significant direct and indirect interactions involving people and their livestock (table 1 in Berger et al. 2013) that von Wehrden et al. ignore (Fig. 1, left). Disregarded are effects of humans and associated infrastructure which accompany grazing practices that affect biodiversity. Dogs for example often escort herds and herders and chase and sometimes prey on wildlife (Young et al. 2011). Motorcycles similarly displace native herbivores, and native species can abandon use of livestock watering points. The presence of temporary housing structures reduces native wildlife abundance (Olson 2011). Beyond direct effects are sublethal ones, which include negative impacts on behavior, physiology, and diet, as well as displacement from preferred habitats. Additionally, a substantive literature demonstrates disease and parasites from livestock may threaten native species. Nonequilibrium vegetation dynamics is but a single component of the externalities associated with livestock, especially goats.

Von Wehrden et al. suggest "...nomadism is a sustainable form of land use in Central Asia." Nowhere in Berger et al. (2013) do we advocate for a cessation of herding goats or cashmere production. While we do not know what von Wehrden et al. mean by *sustainable*, nomadism itself can—and perhaps should—persist indefinitely. This is not the question, however. Rather, the question is, to what extent can wildlife persist with nomadism, especially when livestock populations increase and herd composition (in favor of goats) is driven largely by international demand for products such as cashmere? What is of fundamental importance is to determine how pastoral production practices could be altered to facilitate the maintenance of biodiversity.

Use of Selected Literature

Von Wehrden et al. seem to miss the relevance of the cashmere market to the increase in goats and to ignore the role of livestock in non-equilibrium dynamics. For instance, they cite Tachiiri et al. (2008) to bolster their claim that "collapses in livestock numbers have been driven primarily by climate." In doing so, they understate the varying role of factors identified by Tachiiri et al. (2008) that work in consort with weather. To quote Tachiiri et al. (2008:2252), "According to the model, serious livestock mortality was associated with low NDVI values [i.e., poor vegetation] in August of the previous year, high SWE values [i.e., significant snow accumulation] in

December of the previous year, a high previous year's mortality, and high previous year's livestock population."

Further, von Wehrden et al. state, "Extreme climatic events continue to influence livestock numbers on a local (Kaczensky et al. 2011; Tachiiri et al. 2008) and nationwide scale (Saizen et al. 2010) . . . " By calling into doubt cashmere as a market driver, they ignore important statements in the very same literature they cite. Saizen et al. (2010:640) offer, "The steep growth in the number of goats resulted from a strong demand for goat hair, or cashmere." Saizen et al. (2010) also note that goats were the only species of livestock in Mongolia to increase from 1992 to 2006, a change one would not expect if livestock numbers were driven purely by climate. Saizen et al. (2010) further indicate that goats respond less to climate than other livestock species.

Two more recent papers further call into question claims by von Wehrden et al. First, Hilker et al. (2014:418) state, "Our results suggest that the cumulative effect of overgrazing is a primary contributor to the degradation of the Mongolian steppe and is at least partially responsible for desertification reported in previous studies." Second, Liu (2013) not only point to cashmere as a driving force underlying the increase in goat numbers, but their results, as in the other studies, similarly show that livestock herd densities contribute to ecological degradation. While equilibrium and nonequilibrium conditions are dynamic and by definition modulated by both abiotic and biotic factors (Mishra & Rawat 1998; Mishra et al. 2001), little is known about how livestock densities affect biodiversity in the Gobi or whether effects are trivial as inferred by von Wehrden et al.

Conservation and Next Steps

Von Wehrden et al. suggest that we should hesitate to condemn traditional pastoralism and other forms of land use that are more sustainable than the lifestyles of most people in the West. This may indeed be valid. But it should not mean that we must reflexively defend any land use practice by traditional societies as sustainable even in the face of evidence to the contrary. Conservation of biodiversity will not progress if we hesitate to investigate and point out where the causal problems lie because that is where conservation solutions will emerge. Despite the focus by von Wehrden et al. on Mongolia, a broader view is called for.

Our paper has had sufficient attention to result in twin projects, one in northern India and another in southern Mongolia. We and our colleagues are working with herders to understand local reliance on goats and the extent to which external forces and financial incentives might change pastoral practices to accommodate the conservation of wildlife. Engaging in dialogue and gathering new information at the local level is a place to begin. Yet, the cashmere connection and its overarching impact across lands that, in addition to Mongolia, include parts of China and India, means that voices must be heard and solutions proffered from many corners.

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