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Impact of livestock on giant pandas and their habitat

Vanessa Hull[a,*], Jindong Zhang[a,b], Shiqiang Zhou[c], Jinyan Huang[c], Andrés Viña[a], Wei Liu[a,d], Mao-Ning Tuanmu[a], Rengui Li[c], Dian Liu[c], Weihua Xu[b], Yan Huang[c], Zhiyun Ouyang[b], Hemin Zhang[c], Jianguo Liu[a]

[a] Center for Systems Integration and Sustainability, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48823, USA
[b] State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China
[c] China Conservation and Research Center for the Giant Panda (CCRCGP), Wolong Nature Reserve, Sichuan 623006, China
[d] International Institute for Applied Systems Analysis, Schlossplatz 1, A-2361 Laxenburg, Austria

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ABSTRACT

Livestock production is one of the greatest threats to biodiversity worldwide. However, impacts of livestock on endangered species have been understudied, particularly across the livestock–wildlife interface in forested protected areas. We investigated the impact of an emerging livestock sector in China's renowned Wolong Nature Reserve for giant pandas. We integrated empirical data from field surveys, remotely sensed imagery, and GPS collar tracking to analyze (1) the spatial distribution of horses in giant panda habitat, (2) space use and habitat selection patterns of horses and pandas, and (3) the impact of horses on pandas and bamboo (panda's main food source). We discovered that the horse distribution overlapped with suitable giant panda habitat. Horses had smaller home ranges than pandas but both species showed similarities in habitat selection. Horses consumed considerable amounts of bamboo, and may have resulted in a decline in panda habitat use. Our study highlights the need to formulate policies to address this emerging threat to the endangered giant panda. It also has implications for understanding livestock impacts in other protected areas across the globe.

Introduction

One of the most significant drivers of global land use change is livestock production, a fast growing economic sector currently affecting 23 of the 35 global biodiversity hotspots (Rindfuss et al. 2008; Steinfeld et al. 2006). Livestock can have a profound impact on biodiversity by promoting habitat loss and degradation, global climate change, pollution, spread of invasive species, and disease transmission (Steinfeld et al. 2006). Livestock also may directly compete with wildlife species for limited food and space, in turn threatening their survival (Madhusudan 2004; Mishra et al. 2004). Vulnerable to such competition are herbivorous species (particularly threatened/endangered species) that share similar dietary restrictions and foraging strategies as livestock (Beck & Peek 2005; Namgail et al. 2007; Young et al. 2005).

One endangered animal species that may be affected by livestock production is the giant panda, a large herbivorous mammal and international symbol for biodiversity conservation (Hull et al. 2011). The ca. 1600 remaining wild pandas are native to the mixed deciduous and coniferous forests in southwestern China (State Forestry Administration 2006), where they inhabit isolated mountain ranges fragmented by the activities of a growing human population, including farming, road construction and timber harvesting (Chen et al. 2010). Over 60 nature reserves have been established to protect giant pandas (Viña et al. 2010), but reserves may not always provide a sufficient regulatory framework to prevent further panda habitat degradation (Liu et al. 2001).

In the most comprehensive survey of giant pandas and their habitat to date, the 3rd National Giant Panda Survey, surveyors spanned the entire geographic range of the species to document evidence of both giant panda habitat use and human disturbance (State Forestry Administration 2006). In this survey, out of ten different types of human disturbance identified, livestock grazing was the second most commonly encountered type (11% of 34,187 plots, 17% of all disturbances), behind only timber harvesting (28% of the plots, 41% of all disturbances). However, timber harvesting was determined to be a legacy effect (i.e., not occurring at the time of

* Corresponding author at: Center for Systems Integration and Sustainability (CSIS), Michigan State University, 1405 South Harrison Road, Suite 115 Manly Miles Building, East Lansing, MI 48823-5243, USA. Tel.: +1 517 230 2135; fax: +1 517 432 5066.
E-mail address: hullvane@msu.edu (V. Hull).

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survey) in more than 90% of the observed cases due to a successful national timber harvesting ban (State Forestry Administration 2006). On the other hand, 93% of livestock grazing incidences were deemed to be ongoing at the time of the survey. Livestock grazing was also the most prevalent disturbance in one recent study spanning the entire Minshan mountain range (livestock disturbance found in 19% of over 1600 sample plots, Wang 2008). However, as far as we know, there is little monitoring and management of livestock production in the panda's geographic range, even inside nature reserves.

Despite the recorded prevalence of livestock across giant panda habitat, research on the nature of the impacts on pandas and their habitat is limited to a small number of case studies in the Chinese literature (Kang et al. 2011; Ran, 2003; Ran et al., 2003; Ran et al., 2004). These studies reiterated the findings of the 3rd Giant Panda Survey about the prevalence of livestock disturbance in panda habitat, in addition to showing that there is some overlap in the habitat selection of pandas and livestock. However, many questions remain regarding the space use and habitat selection of individual livestock animals, spatial distribution of livestock impacts on panda habitat and the nature of the impacts. Of particular concern is whether livestock could threaten the sustainability of the giant panda's main food, understory bamboo, a food source that is not believed to be threatened by any other animal competitor (Schaller et al. 1985).

We set out to fill these information gaps in Wolong Nature Reserve, a flagship reserve for giant panda research and a driver of policy making for the conservation of this endangered species (Tuanmu et al. 2010; Viña et al. 2008). We analyzed data obtained from forest surveys, remote sensing and Global Positioning System (GPS) collar telemetry to investigate the effects of an emerging livestock sector in this Reserve—the rearing of domestic horses. Our primary interest was in determining whether forest encroachment by horses could threaten the giant panda by occupying suitable habitat and consuming bamboo. Our objectives were to: (1) assess horse distribution with respect to panda habitat suitability and panda distribution, (2) compare space use and habitat selection patterns of horses and wild pandas, and (3) analyze the impact of the horse herds on bamboo biomass and on panda habitat use.

Methods

Study area

Wolong Nature Reserve is located in Wenchuan County, Sichuan province, China (102°52′–103°24′E, 30°45′–31°25′N, Schaller et al. 1985, Fig. 1). It is one of the largest reserves for the conservation of giant pandas (2000 km^2) and harbors 10% of the total wild giant panda population (Liu et al. 2001; State Forestry Administration 2006). There are also over 10,000 plant and animal species found in the Reserve (Tan et al. 1995) owing to its wide elevational range (1200–6250 m, Schaller et al. 1985). The giant pandas mainly inhabit mixed deciduous broadleaved coniferous forests at intermediate elevations of 2250–2750 where they forage on bamboo, which can cover up to 95% of the forest understory area (Schaller et al. 1985). Giant pandas are solitary mammals and are obligate bamboo foragers, with bamboo making up over 99% of their diet throughout all seasons of the year (Schaller et al. 1985).

The Reserve is also home to nearly 5000 human residents who are mainly farmers. With respect to livestock, residents raise cattle, pigs, goats, and yaks for meat (Ghimire 1997). Yaks make up the largest group of livestock, with over 3000 animals in the Reserve, followed by goats and cows (~1500 animals each, Wolong Nature Reserve 2008). Historically, horse rearing was rare in the Reserve (less than 25 horses occurred in the entire Reserve as recently as 1998). Although horses now make up the smallest proportion of all livestock animals at just under 350 heads (in approximately 20–30 herds), the number of horses has increased tenfold from 1996 to 2008 (Wolong Nature Reserve 1996, 2008). The growth in this sector can be attributed to telecoupling processes (Liu et al. 2013) such as selling horses to regions far away from Wolong and to strengthening agricultural business exchanges between Wolong residents and those in Xiaojin township (located outside of giant panda habitat and adjacent to the Reserve on its western side), where horse rearing is prominent.

Table 1
Summary of four domestic, free-ranging horse herds monitored in giant panda habitat in Wolong Nature Reserve, China.

Horse herd	*n*	Year introduced	Type of analysis
Fangzipeng	16	2007	Field survey
Papagou	12	2004	GPS collar
Qicenglou	5	2011[a]	GPS collar
Yusidong	23	2004	GPS collar, field survey

[a] But previously held as part of a larger herd (n = 20) at Huangcaoping and Laowashan; was moved back to Huangcaoping on 2/7/2012 (see Fig. 1).

Horses are supposed to be contained year round in existing grazing areas. However, in recent years, some horse herds have been excluded from grazing areas because they over-consumed grasses. As a result, horse herders have sent their horses to nearby forests (and panda habitat) to graze separately from the cattle. In these forests we have observed horses to forage largely on bamboo, since it is the most available plant matter present in the understory. To our knowledge, this practice has occurred with at least four horse herds in Wolong. Horse herders only visit their herds approximately once per month and do not spatially contain their activities.

Study subjects

We monitored four focal herds of horses (hereafter Yusidong, Qicenglou, Papagou and Fangzipeng, after the name of the local regions where they graze) inhabiting giant panda habitat in Wolong. These herds were not chosen as representative of all livestock production systems occurring across the entire reserve but for analyzing the emerging trend of forest encroachment by horses (i.e., the herds chosen inhabit forests in the Reserve). All herds have only recently been introduced to their respective forest areas (Table 1). The Yusidong, Qicenglou, and Papagou herds were monitored by placing a GPS collar on one member of each herd. Of those, the Yusidong herd is the largest (23 horses). The Fangzipeng herd was monitored using field surveys only (since additional GPS collars were not available).

We also monitored three wild giant pandas (two adult females—Mei Mei and Zhong Zhong and one adult male—Chuan Chuan) using the same type of GPS collars. These pandas occupied an area in close proximity to the Yusidong herd (Fig. 1). While these pandas constitute a small sample, like many other endangered species (Gill et al. 2008; Miller et al. 2010), it is not feasible for the government to give permits to study many individuals using GPS collars. Nevertheless, this is the first spatially explicit account of sympatric panda and horse behavior using high accuracy GPS collar telemetry. The use of wild pandas for this project was approved by the State Forestry Administration of China. The China Conservation and Research Center for the Giant Panda (CCRCGP) was responsible for all animal care procedures. Efforts were made to limit disturbance to animals to short periods required for initial anesthetization and collar deployment. To keep the time period constant across individuals, we restricted the data used in this analysis to a one-year period (between 6/15/2011 and 6/15/2012 for all pandas and horses except Mei Mei, a female panda monitored from 6/15/2010 to 6/15/2011).