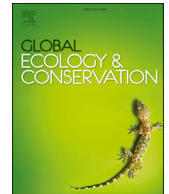




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Original Research Article

Population dynamics and space use of wild boar in a tropical forest, Southwest China

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ABSTRACT

Wild boar (*Sus scrofa*) is the most common native wildlife species causing crop damage in some regions of China. However, in Tropical East Asia, there is limited knowledge on wild boar ecology for application in management and policy decisions. To address this void, we examined wild boar sex-age class structure, group size and space use variation in the Naban River Watershed National Nature Reserve in Xishuangbanna Dai Autonomous Prefecture, Yunnan province, Southwestern China, using 4 years of camera trap data. We found that the adult sex ratio was slightly skewed towards females, and that adults and subadults were the dominant age classes. The annual relative abundance for each age class exhibited a bimodal distribution pattern: the abundance of subadults and adults peaked in May and October, while the abundance of piglets peaked in June and October. Mean group sizes (1.6 ± 1.1) were smaller than the typical mean group of 4 individuals observed in Europe. The space use patterns differed by age class, with piglets preferring forest interior regions while adult males were active near the villages. As such, controlling the adult male population is the most direct way to address crop raiding concerns. On the other hand, protecting piglets would have beneficial effects as potential prey for rare carnivore species of conservation concern that are limited to reserve inner zones.

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1. Introduction

The wild boar (*Sus scrofa*) is one of the most widely distributed ungulates in the world due to its high reproductive rate, adaptability, and opportunistic feeding (Herrero et al., 2006; Cuevas et al., 2010; Ballari and Barrios-García, 2014). Moreover, it has been introduced deliberately or accidentally to many areas outside its natural range (Barrios-García and Ballari, 2012). In many places wild boars are considered a pest species because they damage food crops, transmit diseases to livestock (Meng et al., 2009), cause traffic accidents (Colino-Rabanal et al., 2012), and negatively impact on native fauna and flora (Engeman et al., 2010). At the same time, the wild boar is an important prey base for endangered large carnivores (Karanth and Sunquist,

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1995) as well as a robust species for hunting that can relieve pressure on other wildlife species (Barrios-García and Ballari, 2012). As such, wild boar management presents a unique conservation challenge.

Wildlife managers interested in developing management policies that represent the broad range of public interest in the species will require better information about population composition and habitat-use patterns. Previous studies conducted in Europe reported that wild boar populations are matriarchal and that their group sizes fluctuate based on breeding activity and seasonality (Poteaux et al., 2009; Maselli et al., 2014). Although much has been published about the ecology and biology of wild boars in Europe, little is known about the populations inhabiting tropical East Asia.

Tropical East Asia (TEA) has experienced severe forest loss in recent decades (Sodhi et al., 2009) precipitating a series of conservation problems, such as alien invasives (Corlett, 2010) and conversion of forests to commercial plantations (Edwards et al., 2014). Intense hunting pressure further threatens the region's vertebrates and forest function, so most tropical nature reserves have become empty forests, such that bird and mammal species larger than 2 kg have been extirpated or have extremely low abundances (Kurten, 2013; Harrison et al., 2016). However, wild boar populations appear to be resistant to both hunting pressure (poaching) and deforestation as it is still a common native ungulate species in TEA (Steinmetz et al., 2010).

In China, lethal measures for controlling crop depredation by wildlife are banned and all non-lethal measures, except for increasing the presence of humans in fields, are ineffective, which has resulted in increasingly frequent and severe crop damage by the wild boar (Cai et al., 2008; Hua et al., 2016). In Yunnan province alone, wild boars caused 14,933,000 RMB of economic loss and the death of eight people during 2009 (Cai et al., 2011). Yet there is no research on the life history parameters (e.g., sex and age structure, group size, space use) of wild boar in China as well as a paucity of studies across TEA, which presents a critical knowledge gap for the management of this species.

It is not easy to choose an appropriate method to monitor species that are rare or elusive. Wild boar are notoriously difficult to observe, especially in tropical forest, because of their preference for habitats that are difficult for humans to reach, such as mountain areas (Acevedo et al., 2006) and forested habitats (Boitani et al., 1995). The camera trap method, as a non-invasive technique, allowed researchers to solve this problem and has been proven to be efficient for monitoring rare or elusive species (Karanth and Nichols, 1998) as well as investigating population density (Karanth and Nichols, 1998), habitat selection (Tobler et al., 2009), activity patterns (Ikeda et al., 2016), social structure (Maselli et al., 2014) or even sexual segregation of forage patch use (Biggerstaff et al., 2017). Thus, in the present study we used camera traps during a four-year field study of wild boars to investigate the structural population parameters of wild boar, including sex-age class structure, group size, and habitat use in the Xishuangbanna Dai Autonomous Prefecture, Yunnan Province, southwestern China.

2. Materials and methods

2.1. Study area

We conducted our study in the Naban River Watershed National Nature Reserve (NRWNNR), which is located in the northern part of Xishuangbanna. Xishuangbanna is part of the Indo-Burma biodiversity hotspot and contains 16% of the vascular plant species, 21.7% of the mammals, and 36.2% of the birds in China, but only accounts for 0.2% of the land area (Zhang and Cao, 1995). The NRWNNR ranges from longitude 100°32' to 100°44' and latitude 22°04' to 22°17' (Fig. 1). The topography of NRWNNR is hilly with narrow and deep valleys, and elevations that range from 539 to 2304 m above mean sea level. Based on the weather station located within our study area, the mean annual precipitation and temperature were 1100–1600 mm and 18–22 °C, respectively. The climate is semi-humid north tropical-subtropical, with clear wet (May to October) and dry (November to April) seasons (Pu et al., 2006). The forest landscape is composed of tropical seasonal rain-forest, tropical monsoon forest, subtropical evergreen broad-leaved forest, warm conifer forests, and bamboo forest (Xu et al., 1990).

Local village residents usually enter the NRWNNR interior to collect non-timber forest products such as wild mushrooms, bamboo shoots (*Cephalostachyum pergracile*, *Dendrocalamus hamiltonii*, *Pleioblastus amarus*, etc.), firewood, etc (Ghorbani et al., 2012). Despite restrictions on hunting under Chapters III and IV of China's Wildlife Protection Law of 1988, poaching of red muntjac (*Muntiacus muntjak*), sambar (*Rusa unicornis*), leopard cat (*Prionailurus bengalensis*), wild boar, silver pheasant (*Lophura nycthemera*), and jungle fowl (*Gallus gallus*) sometimes occurs in NRWNNR. In addition, crops are allowed to be grown in the areas surrounding the nature reserve, causing human-wildlife conflicts by wildlife crop damage.

Historically, the main predators of wild boars were probably the tiger (*Panthera tigris*) and leopard (*Panthera pardus*). However, both have not been observed for nearly 20 years in the study area (G. Cao, personal communication). Our four years (2012–2015) of camera observations also showed that other potential predators like the Asian black bear (*Ursus thibetanus*), Asian golden cat (*Catopuma temminckii*), and dhole (*Cuon alpinus*) are also extremely rare. Concomitantly, the wild boar is now the most common ungulate in the NRWNNR and the surrounding areas (Treydte et al., 2014). They are the main species that causes crop compensation claims in NRWNNR (G. Cao, personal communication). Thus, local people face a problem trying to alleviate the conflict between wildlife conservation and economic income. However, there has been no research related to mammals of NRWNNR except a short-term survey of ungulates (Treydte et al., 2014), so the knowledge of wild boar populations in NRWNNR remains limited.

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