Short communication

A preliminarily assessment of landscape factors affecting habitat use by Przewalski horses and habitat evaluation in Hustai National Park, Mongolia

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ABSTRACT

Przewalski horses (*Equus ferus przewalskii*) bred in captivity in foreign zoos have been reintroduced to Hustai National Park (HNP) in Mongolia. To successfully return horses to their former wild habitat, we need reliable information regarding their habitat use. Hence, the purposes of this study were to examine the landscape context affecting habitat use by Przewalski horses and to identify potential suitable habitat areas in HNP. To clarify the factors affecting the horses' habitat use, we constructed a generalized linear model (GLM) based on fecal counts taken from 48 randomly sampled field plots in HNP. The fecal number counted in each plot was defined as the dependent variable in the model, and we included seven explanatory variables that may affect Przewalski horses' habitat use: distance to a river, distance to forest, distance to a road, slope, difference of elevation with surroundings, number of plant communities, and presence of dominant forage plant categories. Finally, we used the most parsimonious model to identify potential suitable habitat areas on a cell-based map of HNP. The GLM that best explained fecal density was the full model containing all explanatory variables, indicating that Przewalski horses' habitat use is influenced by resources essential to maintaining their survival and by the livelihood of risk. According to our habitat evaluation based on the most parsimonious model, it appears that suitable habitat areas were scattered in the outer side of HNP. These results indicate that Przewalski horses could extend their habitat area beyond their current distribution.

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Introduction

The Przewalski horse (*Equus ferus przewalskii*)—the only extant species of wild horse—was first described in Mongolia in 1881. Although these horses were once widely distributed across Eurasia, they became extinct in the wild in 1960s, mainly due to competition with livestock and habitat degradation (Boyd, 1998). In 1992, 16 Przewalski horses bred in captivity in a zoo in the Netherlands were reintroduced to Hustai National Park (HNP). With the aid of a breeding and conservation program managed by an international team, the number of Przewalski horses in HNP had reached 270 by 2012 (Bandi and Usukhjargal, 2012).

Understanding the landscape context at multiple spatial scales is key to determining the distribution of animals (Mazerolle and Villard, 1999; Steffan-Dewenter et al., 2002). A previous study showed that the distributions of Przewalski horses within HNP was non-random (Bandi and Usukhjargal, 2012), suggesting that they select habitat depending on the landscape context at a certain scale. However, it is not clear how Przewalski horses recognize landscape context and select habitat in HNP. Hence, the purposes of this study were to analyze the landscape context and identify potential suitable habitat areas in HNP.

Material and methods

Study site

HNP (57,000 ha, 47°41′N, 105°54′E, elevation 1100–1840 m) is located about 100 km west of Ulaanbaatar, the capital of Mongolia. The climate is typically continental with a yearly precipitation of 270 mm, most of which falls in the summer, and a mean annual temperature of +0.2 °C, with average monthly temperatures varying between −23 °C (in January) and +20 °C (in July) (de Vries et al., 1996).

HNP has a mountain forest steppe biome that consists of steppe, meadow, grassland, shrub, and woodland communities. Silver birch

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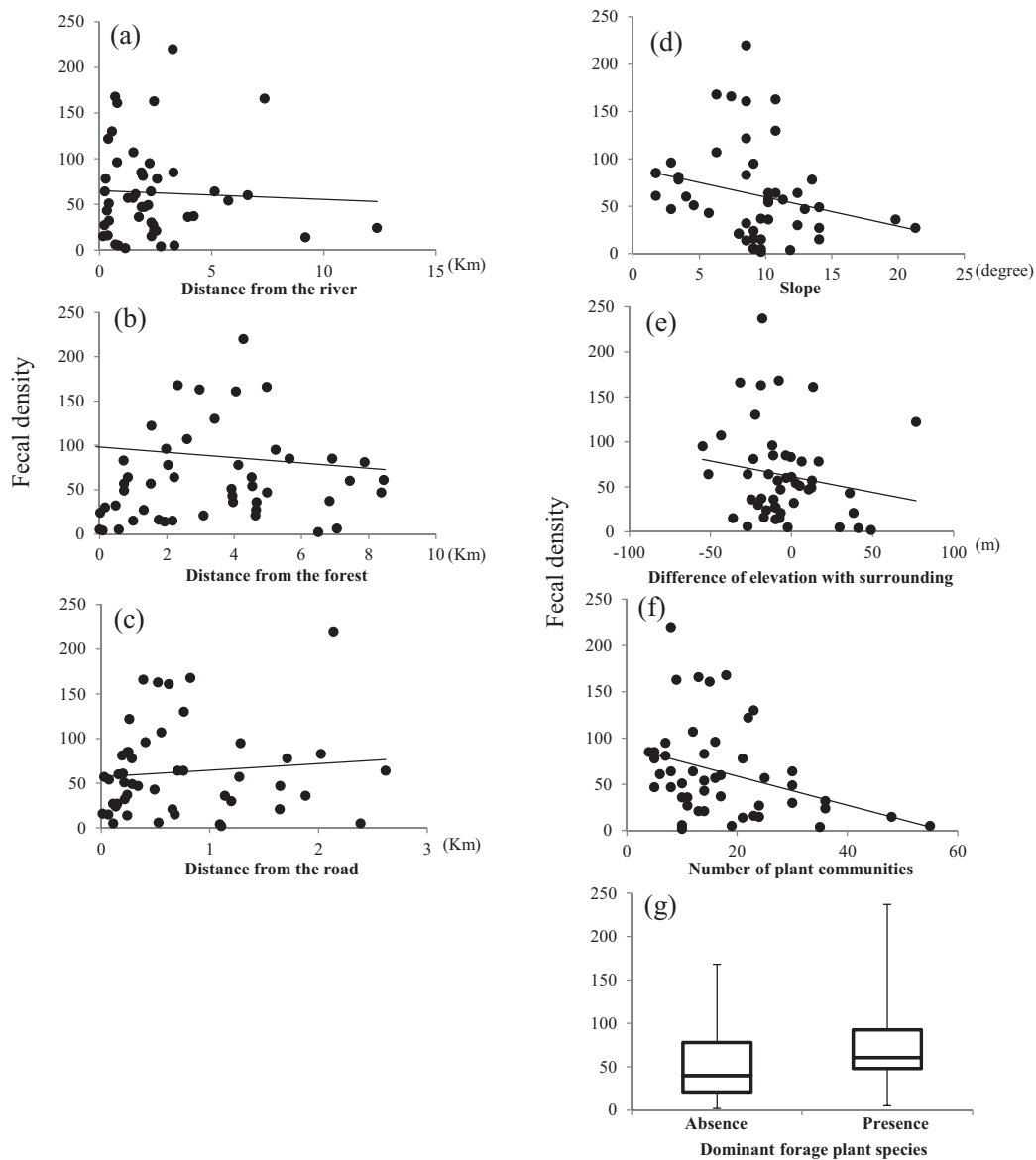
Fig. 1. Relation between the number of feces in sample plots and seven explanatory variables composing the most parsimonious model explaining habitat use by Przewalski horse in Hustai National Park, Mongolia. Graphs show the relation for (a) distance to a river, (b) distance from forest, (c) distance from a road, (d) slope, (e) elevation variability, (f) number of plant communities, and (g) presence–absence of preferred plant species (see main text). Black dots represent the 48 plots sampled in 2013.

(*Betula platyphylla*) and poplar (*Populus tremula*) forest covers 5% of the park, and water flows down most of the valleys as streams (de Vries et al., 1996). In addition to reintroduced Przewalski horses, other large ungulates in the park include red deer (*Cervus elaphus*) and Mongolian gazelles (*Procapra gutturosa*). There are also several carnivore species, although wolves (*Canis lupus*) are the only real threat to the horses (King, 2002).

Field sampling and factors affecting Przewalski horses' habitat use

Across the study area, we randomly placed 48 plots (50 m × 50 m) in summer 2013. We used fecal density as a proxy of time spent in a location during summer. In turn, we counted the number of Przewalski horses' fresh feces once in each plot during summer. Counts were conducted by 3 observers.

Habitat use of large wild herbivores is influenced by biotic and abiotic features, including the presence of predators, and adverse weather conditions (Mobæk et al., 2009). According to King and Gurnell (2005), Przewalski horses require a source of drinking water, shade areas, minerals and forage, and all of which affect range size. Thus, we included in the model seven explanatory variables that may influence Przewalski horses' habitat use: distance to a river, distance to forest, distance to a road, slope, elevation variability (difference of elevation with surroundings), number of plant communities, and presence–absence of dominant forage plant categories. We did not include forage abundance as an explanatory factor in the model because plant biomass in our study area is fully abundant during summer, and under such conditions, forage should not regulate horse use patterns (Girard et al., 2013).

The positions of study plots and layers containing landscape information, such as rivers, forests, roads, topographic contours, and plant communities, were overlaid on the map using ArcGIS, Ver.10.0 (ESRI). We used the Euclidean distance tool in ArcGIS to determine distances to the nearest river, forest, and road for each plot.

To determine the dominant forage plant categories, we used a fecal analysis method. Fecal pellets of five Przewalski horses were collected in HNP. They were washed thoroughly in water