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Recording movement pattern of cattle by GPS data loggers in Lao People's Democratic Republic

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Abstract

We investigated the movements of grazing cattle with GPS data loggers in central Lao PDR. The mean movement speed of the cattle was 0.33 ± 0.07 km/h, and 97.5% of the recorded speeds are lower than 1.4 km/h. This suggested that the most of the time the cattle moved in a relatively slow speed, probably associated with feeding. Using the kernel density estimation, we revealed that the cattle moved little and gathered in one place at night, while they used a large area in daytime. The nocturnal inactivity may be a response to the low light levels at night and/or nocturnal predators.

Keywords: global positioning system, geographic information system, cattle, grazing behavior, Lao PDR

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Introduction

Cattle have many roles for human life not only as a food, but also as a capital asset, draught power and transportation. Grazing distribution patterns of cattle and other domestic animals are affected by factors such as the presence of predators (Hernandez et al., 1999, Rutter, 2006), topography and distance to water (Senft et al. 1987, Smith 1988), and productivity of grazing area (Senft et al. 1985). Therefore, the recording movement patterns is important for the sustainable management and production of cattle husbandry.

In Lao People's Democratic Republic (PDR), about 75% of the population depend on agriculture and forest products for a living (ADB, 2006), and livestock production in Lao PDR contributes approximately 15% to the national GDP (GOL, 2005). The residents traditionally keep small numbers of livestock by free grazing and sell them occasionally. However, little is known about the grazing behavior of cattle in Lao PDR, while a lot of information about economic and cultural aspects of domestic animals is available (Millar and Photakoun 2008, Takai and Thanongsone, 2010).

Recent advances in electronic technology have made it possible to examine the movement of domestic animals with high accuracy and few disturbances (Putfarken et al. 2008). The aim of this study was to investigate grazing patterns and spatial locations of cattle under free-ranging condition by using Global Positioning System (GPS) data loggers in Lao PDR.

Materials and Methods

Status of Paksuun village

Our study was conducted at Paksuun village (18°20'N, 104°03'E), Pak Kading District in Borikhamxay Province, Lao PDR (Figure 1) on 24-26th August 2010. According to the village chief, Paksuun village has approximately 30 cattle that graze all day under free-ranging condition. The grazing area is located on the other side of the Kading river, away from the village, and is constantly used in all seasons. The residents in Paksuun village give their cattle supplemental salts once or twice a day, to prevent a lack of minerals.

Sunrise and sunset during the experimental period at Vientiane, the capital of Laos, are 0554 and 1829, respectively. Therefore, we defined daytime and nighttime from 0600 to 1830 and from 1830 to 0600, respectively.

GPS recording and GIS analysis

Animal-borne GPS data loggers (Garmin Ltd. Foretrex 101 or Mobile Action Inc. GT-120) were sealed into small polyethylene bags and attached for nine cattle on their collars. The loggers recorded date, time, latitude and longitude. The overall weight of the device and collar was approximately 200 g. The locations were recorded every five minutes. The speed of location change was calculated by dividing the distance covered by the duration between two successive recorded locations.

The grazing distribution of cattle both in nighttime and daytime was established by generating the kernel density estimation method (Worton, 1989) using the ESRI® ArcGIS 10 Spatial Analyst Density tool. We estimated contour levels (<25%, 25-50% and 50-75%) of the locations distribution of the cattle attached GPS. Values are presented as mean ± SD.

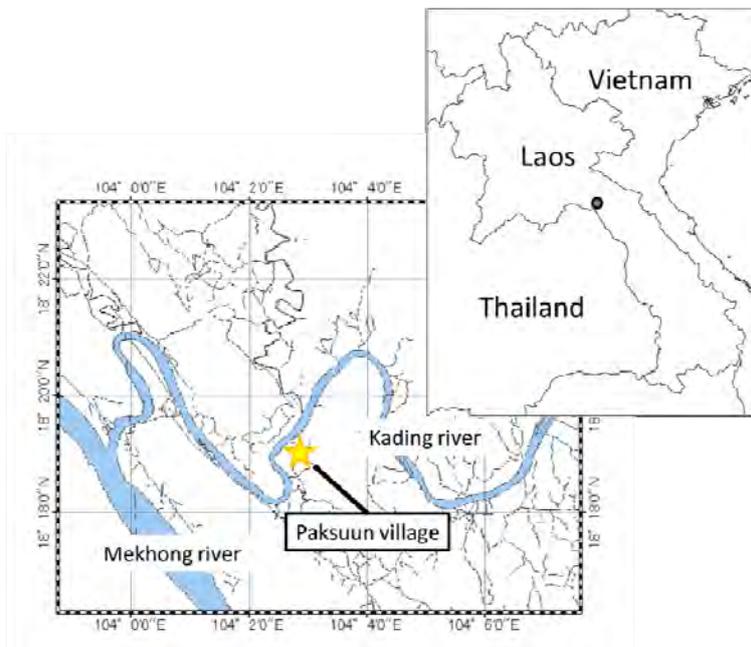


Figure 1. The location of Paksuun village, central Laos.

Results and Discussion

The recovered GPS loggers recorded data during approximately one day (20-26 hours), except two loggers that stopped recording after 6 and 14 hours, respectively. The mean and maximum movement speed of the cattle was 0.33 ± 0.07 km/h ($N = 9$) and 2.56 ± 0.59 km/h ($N = 9$), respectively. In our results, 97.5% of calculated speeds are less than 1.4 km/h. Schlecht et al. (2006) recorded the cattle movement speed during feeding (1.0 ± 0.4 km/h) and walking (2.8 ± 0.5 km/h). Therefore, cattle in Paksuun village usually move slowly, presumably with feeding.

The cattle moved for 5.64 ± 2.39 km ($N = 7$, over 20 hours recording) during the measurement period. The distance covered by grazing cattle ranges 0.3-20 km/day, depending on the size of the pasture or range and the abundance of forage (Houpt, 2011). Cattle in Paksuun village cover relatively short distances and this may be linked to an abundance of forage.

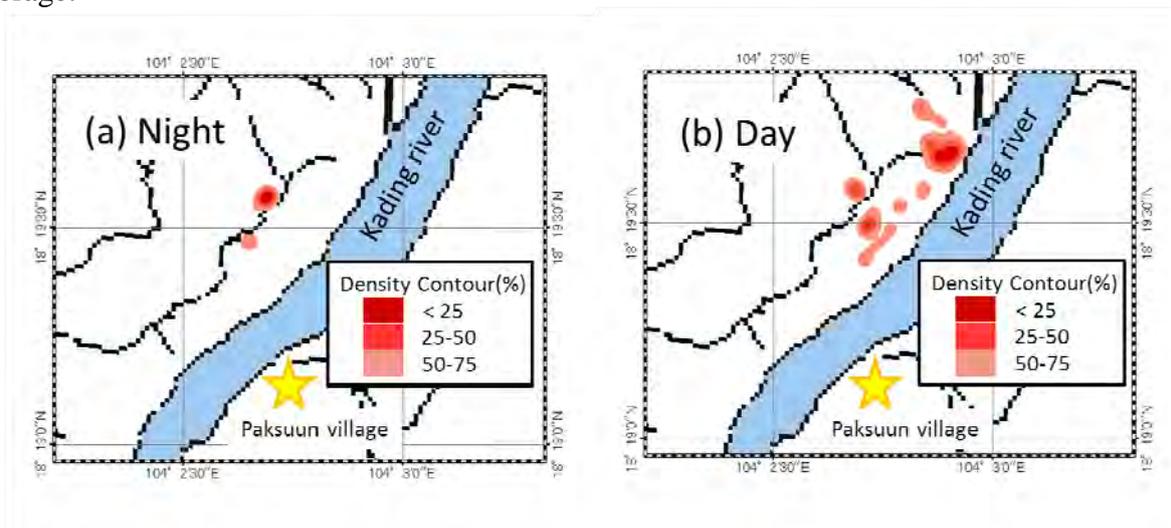


Figure 2. Kernel density distribution of grazing cattle in (a) nighttime and (b) daytime.



Comparing the cattle distributions between nighttime and daytime by kernel density estimation, we found that cattle used smaller areas and gathered in one place in nighttime (Figure 2). This suggests that the cattle in Paksuun village have diurnal characteristics.

In temperate regions, cattle generally avoid grazing at night (Gibb et al., 1998). Rutter (2006) argued that this is an innate anti-predator strategy. Conversely, the feral cattle in Mexico traveled long distances at night (Hernandez et al., 1999). This behavior also indicates an anti-predator strategy in response to hunting by local ranchers in daytime (Hernandez et al., 1999). Therefore, the diurnal characteristics of the cattle in Paksuun village also may be an avoidance behavior from predators. Although we have no information about the conflicts between livestock and predators in Paksuun village, Johnson et al. (2006) documented that tigers *Panthera tigris*, nocturnal predators, prey on livestock in Lao PDR.

As another possibility, the lack of grazing at night may be directly related to low light levels. In fact, Vilela et al. (1974) found that the presence of bright moonlight increased the proportion of grazing time at night in dairy cows, in Brazil.

As a miniature data logger with an acceleration sensor or a digital video was developed, now it is possible to observe remotely domestic and wild animal activities such as feeding, walking and flying (Watanabe et al. 2008, Yoda et al. 2011). These technologies would have potentials to reveal the factors influence to the movement pattern of cattle.

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