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**Short Communication**

# Possibility of night activity shift of Eurasian red squirrel (*Sciurus vulgaris*)

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## Abstract

We investigated activity patterns of wildlife by using 28 camera traps from June 2021 to June 2022 in a forest in eastern Hokkaido, Japan. *Sciurus vulgaris* is generally known as a diurnal species. However, two photos recorded the night activity of this species in March 2022. One photo showed something resembling a pine cone in a squirrel's mouth. *Sciurus vulgaris* might shift the timing of their activity patterns to avoid predators such as *Vulpes vulpes* and/or to forage food when scarce.
**Keywords**: forage, nocturnal activity, sensor camera

## Introduction

The natural activity of mammals generally shows either nocturnal, diurnal, or crepuscular behavior. However, some species shift the activity time due to human disturbance (George & Crooks, 2006; Gaynor et al., 2018), a change in habitat conditions (Brook et al., 2012), or the presence of predators (Long et al., 2013; Bonnot et al., 2016) and invasive species (Zapata-Ríos & Branch, 2016). For example, mule deer (*Odocoileus hemionus*) change to nocturnal from diurnal activity when predators are present in their area (Bonnot et al., 2016). Moreover, field voles (*Microtus agrestis*) change their nocturnal activity to diurnal activity in winter, although the reason for this has not been clearly shown

(Bäumler 1975).

Eurasian red squirrels (*Sciurus vulgaris*) are widely distributed from the British Isles to the Eurasian Continent and Hokkaido, Japan (Lurz et al. 2005). This species inhabits a range of environments, from urban parks to coniferous and broad-leaved forests. In Hokkaido, Eurasian red squirrels also are distributed from mountainous areas and residential areas such as urban parks. People taking a walk in the park can frequently find Eurasian red squirrels in the morning. It is known that the distance between people and squirrels in the park is closer than that in the rural area (Uchida et al., 2016). Eurasian red squirrels especially prefer seeds and nuts in their diet with various food items (Lee 2002). It is already known that this species is diurnal and active from sunrise to sunset past studies and observations (Tonkin, 1983; Babińska-Werka & Żółw, 2008; Steen & Barmoen, 2017).

However, contrary to previous studies, we observed two cases of nocturnal activity of Eurasian red squirrels. Therefore, this paper reports on the first observation of nocturnal activity by Eurasian red squirrels in Hokkaido, Japan.

## Materials and methods

To investigate the activity pattern of wildlife in an urban forest, 28 sensor cameras (Strike Force HD PRO X, Browning) were set up from June 2021 to June 2022 in a 46-hectares forest in Obihiro City of eastern Hokkaido, Japan (42°53′ N, 143°9′ E). This forest consisted of coniferous trees such as *Picea glehnii*, *Abies sachalinensis*, *Pinus koraiensis* and *Larix kaempferi*, and broad-leaved trees such as *Quercus dentata*, *Betula platyphylla* and *Juglans mandshurica*. Each camera site was selected by a 200 m x 200 m grid using GIS. The height of the cameras was 1–1.5 m fastened to tree trunks in random directions. Camera data was collected every two to three months. Then we recorded species and the date captured by the camera trap.

## Results and discussion

Camera traps captured over 100 photos of Eurasian red squirrels. Only two of the photos of the squirrels were captured at night in March 2022. One Eurasian red squirrel was recorded at 18:23 on 24 March 2022 (sunset time was 17:45) (Fig. 1).


**Figure 1**. Night activity of *Sciurus vulgaris* which holds a pine cone in its mouth captured at 18:23 on 24 March, 2022

The photo showed something resembling a pine cone in the squirrel's mouth. Another red squirrel photo was recorded at 0:57 on 24 March 2022 by the same camera as the first photo (sunrise time was 5:23) (Fig. 2).


**Figure 2.** Midnight activity of Sciurus vulgaris captured at 0:57 on 25 March 2022

We could not determine the squirrel's behavior, for example, if it was carrying something, because only the back of the squirrel was captured in the photo. These squirrels were observed when there was snow on the ground (snow depth was about 25 cm) with a fallen branch of *Larix kaempferi*. The weather was fine on both days; the air temperature was from -0.9 to -2.4 at the time when the red squirrels were captured in the photo.

This study shows that Eurasian red squirrels are active during the night because one photo was taken over 30 minutes after sunset and the other photo was taken before 4.5 hours before sunrise. Additionally, this study suggests that Eurasian red squirrels forage during the night. Eurasian red squirrels have diurnal activity (Tonkin, 1983); however, our findings differ from this basic biology. A shift in activity time has been known in some mammals due to human activity or predation pressure. For example, bobcats (*Lynx rufus*) shifted their daily activity patterns more nocturnally in areas of high human activity (George & Crooks, 2006). On the other hand, Lewis et al. (2021) showed that Abert's squirrels (*Sciurus aberti*) and fox squirrels (*S. niger*) of Sciuridae did not shift their diurnal

activity in areas of high human activity. Our findings on Eurasian red squirrel nocturnal activity is a first for Sciuridae. Such nocturnal activity doesn't seem influenced by human activity. It is known that European brown hares shift their temporal activity pattern when predators are present (Viviano et al., 2021). Also, an activity shift in mice (*Mus musculus*) is affected by the balance between food availability and predation risk during daytime or night (van der Vinne et al., 2019). Therefore, Eurasian red squirrels might shift their activity pattern to avoid predators such as red foxes (*Vulpes vulpes*) and free-ranging domestic cats (*Felis catus*) in the area; and/or to forage scarce food.

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