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Report

Video analysis of the activity budget and activity rhythm of captive Japanese martens *(Martes melampus melampus)*

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Abstract

To investigate the activity budgets of Japanese martens (*Martes melampus melampus*), we conducted 24-hr video recording of captive adult animals (three males and one female). The martens spent a considerable amount of time (> 60% of sampling points) sleeping, and less time (17% on average) dashing. The activity rhythm varied among individuals; for two males, the percentage of active behavior (mainly walking and dashing) was greater before (07:00–09:00 h) and after (12:00–17:00 h) the feeding (10:00), whereas the other male and a female rarely appeared from the nest box during the daytime.

Key words: activity, *Martes melampus melampus,* rhythm, video recording, zoological garden.

Introduction

Being highly specialized in hunting small animals, mustelids are often used as model animals to study the effect of prey availability on predator activity (Alterio and Moller, 1997, Brandt and Lambin, 2005). Such study is useful to understand their feeding strategy in the wild. Previous mustelid studies have found that they show several peaks of activity throughout the day (Alterio and Moller, 1997; Jędrzejewski et al., 2000; Brandt and Lambin, 2005). The majority of previous studies on mustelid activity, however, were based on indirect data obtained from radio-telemetry (Brandt and Lambin, 2005), and thus information on animal activity is still unclear. In this study, we investigated the activity budgets and activity rhythms of captive Japanese martens (*Martes melampus melampus* Wagner). Several researchers have reported that Japanese martens are nocturnal (Hosoda, 1985; Eguchi and Matsumura, 2007), perhaps in response to activity of small rodents (Takamatsu et al. 2005), a main food source for martens (Tatara and Doi, 1994; Tsuji et al., 2014). However, some researchers have reported martens moving in the daytime (Hirakawa and Hosoda, 2006), and details of their activity have been unclear. Although activities observed under captive condition often differ from those in the wild, details of daily activity based on continuous behavioral observation could be useful for understanding the relative time budgets and rhythms of the martens.

Materials and methods

We conducted behavioral observations of four adult martens (three males and one female, aged ≥3

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years in 2010) housed in a reproduction center within the Toyama Municipal Family Park Zoo (TMFPZ hereafter), central Japan. Animals were caught in the wild and moved to the TMFPZ, although the time they had spent in captivity differed. The martens were reared in individual wire-meshed pens (length 1.8 m × width 1.8 m × height 2.0 m). Inside the pens there is a nest box (length 0.6 m × width 0.6 m × height 0.3 m). Individual pens were arranged contiguously, and each animal could see (but could not touch) neighboring individuals. All animals were in good health during the study period, and the female marten (Satsuki) was neither lactating nor pregnant during the period of observations. Zoo keepers entered the reproduction center, switched on the room light at 08:00, and fed the martens once a day at around 10:00. The martens' diet consisted of dead chicks, chicken heads, boiled sweet potatoes, and fresh fruit (total fresh weight: 100–150 g・individual^{-1}) (Tsuji et al., 2011). The zoo keepers switched off the room light and left the reproduction center at around 17:00 every day. We obtained permission for the experiments from the TMFPZ, and our methodology adhered to Japan's legal requirements for animal welfare. We began recording activity in 2010 (Sep 28 –Oct 2; 5 days) and 2011 (Aug 30–Sep 3; 5 days). We pooled the data collected in these two years since the mean temperature at Toyama City, the nearest weather station from the TMFPZ, in the two study periods was similar (23.8°C in 2010 and 22.2°C in 2011), and activity budgets in the 2 years were not different ($p > 0.05$ for each individuals). In each year, 1 to 2 weeks before data collection began, we placed security cameras on the roof of the individual pens in order to accustom the animals to the camera, and we then monitored the movement of the animals for five continuous days. The videos were recorded onto a hard disk. During the study period, except for cleaning, no one entered the individual pens, thus minimizing the possibility of inducing stress in the animals. We analyzed the recorded videos and checked the activity of each marten every 5 minutes by instantaneous sampling. Activities were classified into seven categories: walking, dashing (short bursts of running including jumping), sitting on the nest box or cage floor, remaining in the nest box (defined as sleeping), feeding, grooming, and others (included drinking, alarm, and defecation). In this study, we defined the sum of sitting and sleeping as "inactive" behavior, and the sum of all remaining categories as "active" behavior. The sampling points recorded for a given activity among all sampling points represented the relative rate of the activity throughout the observation. Activity data during cleaning was omitted from the dataset since this seemed to disturb the natural behavior of the animals. To examine whether an activity rhythm exists for the animals, we compared the percentage of active behavior with that of expected activity, which was obtained by dividing the total sampling point time spent in active behavior by the total number of sampling points for each animal using χ^2 tests. To test synchronization of the activity rhythm between two different animals, we performed Wilcoxon signed rank tests for the rate of active sampling points per hour for each pair of animals ($_4C_2 = 6$ pairs). We set the levels of

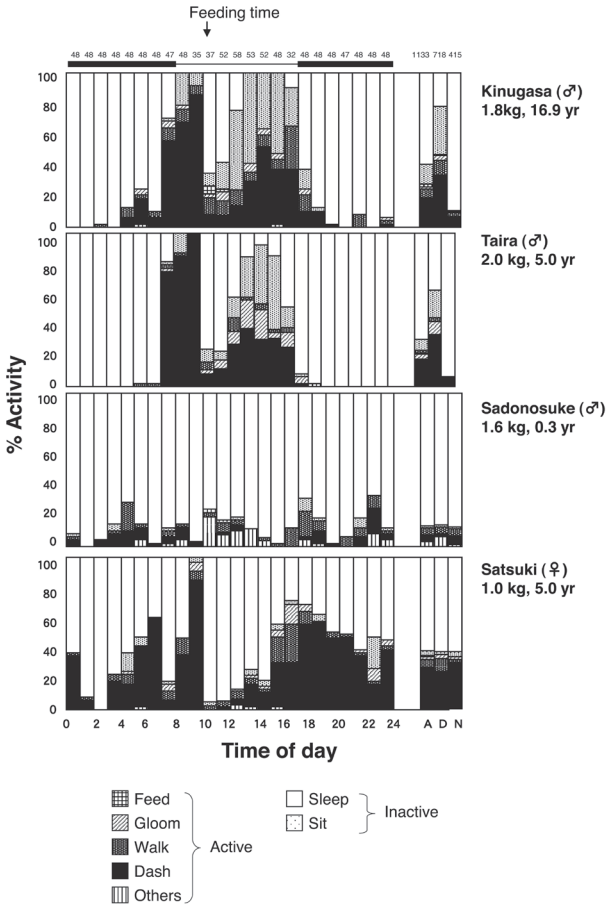

Figure 1. Hourly change, in the percentage of time spent performing each activity, for four captive adult Japanese martens (three males and one female) obtained by video analysis recorded at the Toyama Municipal Family Park Zoo. Figures on the top represent the number of sampling points that were used for each animal. Time of feeding (arrow) and dark conditions (thick line), as well as body weight and rearing duration of each individual, are also shown. A: whole day, D: day time hours, N: night time hours.

significance (α) at 0.05.

Results and Discussion

All subject animals spent more than 60% (range: 61.8% to 86.5%) of their time sleeping (Fig. 1). The high percentage of sleeping is similar to that observed in other mustelid species under wild conditions (e.g., 69% for *Mustela putorius*, Lode, 1995). Among the active behaviors, the martens spent largest proportion of time for dashing (17%, range: 4.1% to 28.1%). The activity was not distributed in a homogenous pattern; for two males (Kinugasa: $\chi^2 = 154.4$, df = 23, $p < 0.001$; Taira: $\chi^2 = 213.7$, df = 23, $p < 0.001$) the percentage of active behavior was greater before (07:00 and 09:00) and after (12:00 and 16:00 or 17:00) the feeding (10:00). Furthermore, the percentage of time that the animals spent sitting was much greater between 13:00 and 17:00. For these animals, nocturnal (after 18:00) behavior was rarely observed (Fig. 1). One male (Sadonosuke), whose rearing period was the shortest, performed alarm behavior frequently, while the other males did not. This animal rarely appeared from the nest box during the day, and the percentage of time spent outside of the nest box for other activities (majority of which was alarm behavior) was greater than that shown by the other animals. There were several small peaks of activity, which occurred at 04:00, 10:00–12:00, 17:00, and 22:00 ($\chi^2 = 36.7$, df = 23, $p = 0.035$) (Fig. 1). Finally, the activity of the female (Satsuki) differed from that of the males: the percentage of active behavior of this animal was greater during the periods 23:00–00:00, 05:00–06:00, 08:00–09:00, and 18:00–21:00 ($\chi^2 = 86.8$, df = 23, $p < 0.001$) (Fig. 1). Except for the pair Satsuki and Sadonosuke ($V = 29.5$, df= 23, $p < 0.001$), the activity rhythm of different animals was not synchronized (Kinugasa and Sadonosuke: $V = 179.5$, $p = 0.086$; Kinugasa and Satsuki: $V = 100.0$, $p = 0.158$; Kinugasa and Taira: $V = 131.5$, $p = 0.145$; Taira and Satsuki: $V = 190.5$, $p = 0.113$; Sadonosuke and Taira: $V = 106.0$, $p = 0.518$). Our results showed that the activity rhythm of Japanese martens was not fixed but showed plasticity, even if housing conditions (food availability, space availability, temperature, and protection from predators) remained constant. The duration of rearing and difference in sex may explain the variation: one male (Sadonosuke) might have been afraid of humans/conspecifics. Hosoda (1985), who studied the activity of captive male martens, concluded that the martens to be nocturnal, and this was confirmed in wild by Eguchi and Matsumura (2007), who evaluated the activity of wild martens by automatic camera. Ohdachi et al. (2009), however, reported that the daily activity rhythm of Japanese martens is not stable; our study confirmed that there was behavioral variation even under captive condition, although its determinants were unclear. In order to correlate the activity budgets and rhythms of the martens with external and/or internal factors, behavioral data collection from more animals across different seasons and under varying diet conditions and temperatures is needed (Lode, 1995; Jędrzejewski et al., 2000; Garin et al., 2002).

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References

Alterio, N. and Moller, H. (1997) Daily activity of stoats (*Mustela ermine*), feral ferrets (*Mustela furo*) and feral house cats (*Felis catus*) in coastal grassland, Otago Peninsula, New Zealand. *New Zealand J. Ecol.*, **21**, 89-95.

Brandt, M.J. and Lambin, X. (2005) Summer-time activity of common weasels *Mustela nivalis vulgaris* under differing prey abundances in grassland habitats. *Acta Theriol.*, **50**, 67-79.

Eguchi, K. and Matsumura, S. (2007) Investigation of fauna and activity of animals on 'animal paths' in Akiyoshi-dai Plateau with automatic camera systems. *Bull. Akiyoshi-Dai Mus. Nat. Hist.*, **42**, 51-64.

Garin, I., Aihartza, J., Zuberogoitia, I. and Bilbo, Z. (2002) Activity pattern of European mink (*Mustela lutreola*) in Southwestern Europe. *Z. Jagdwiss.*, **48**, 102-106.

Hirakawa, H. and Hosoda, T. (2006) A record of baby Japanese marten (*Martes melampus*) in Hitsujigaoka, Sapporo. *North. For.*, **55**, 245-247.

Hosoda, T. (1985) Activity rhythm of the Japanese marten, *Martes melampus melampus* Wagner. *Nanki Seibutsu*, **27**, 81-85.

Jędrzejewski, W., Jędrzejewska, B., Zub, K. and Nowakowski, W.K. (2000) Activity patterns of radio-tracked weasels *Mustela nivalis* in Białowieża National Park (E Poland).

Ann. Zool. Fenn., **37**, 161-168.

Lode, T. (1995) Activity pattern of polecats *Mustela putorius* L. in relation to food habits and prey availability. *Ethology*, **100**, 295-308.

Ohdachi S.D., Ishibashi, Y., Iwasa, M.A. and Saitoh, T. (2009) *The Wild Mammals of Japan*. Shoukadoh, Kyoto, 544 p.

Takamatsu, N., Hirata, R., Hata, K. and Sone, K. (2005) Application of automatic cameras to wildlife studies with special references to foraging behavior of *Apodomus* mice. *Res. Bull. Kagoshima Univ. For.*, **33**, 35-42.

Tatara, M. and Doi, T. (1994) Comparative analyses on food habits of Japanese marten, Siberian weasel and leopard cat in the Tsushima islands, Japan. *Ecol. Res.*, **9**, 99-107.

Tsuji, Y., Shiraishi, T. and Miura, S. (2011) Gastrointestinal passage time of seeds ingested by captive Japanese martens *Martes melampus*. *Acta Theriol.*, **56**, 353-357.

Tsuji, Y., Yasumoto, Y. and Takatsuki, S. (2014) Multi-annual variation in the diet composition and frugivory of the Japanese marten (*Martes melampus*) in western Tokyo, central Japan. *Acta Theriol.*, **59**, 479-483.

和文要旨

飼育ホンドテン（*Martes melampus melampus*）のアクティビティと活動リズムのビデオ解析

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ホンドテン（*Martes melampus melampus*）のアクティビティと活動リズムを明らかにするために、動物園の飼育個体（オス 3 頭、メス 1 頭）を対象に、個別ケージ内の行動の連続ビデオ撮影を実施した。テンは一日の半分以上の時間（サンプリングポイントの 60% 以上）を巣箱の中で過ごし、動き回っている時間は短かった（平均で 17%）。活動リズムは個体により差があった：2 頭のオスは給餌時間の前後（7:00-9:00 と 12:00-17:00）に活動性が高かったが、もう一頭のオスは日中ほとんど巣箱に入ったままだった、メス個体は夜間に高い活動性を示した。

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