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Hair Growth of Brown Bears during Winter

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冬期におけるヒグマの体毛の成長

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Abstract

To examine whether hair of brown bears (*Ursus arctos*) grows during winter, we shaved off the hair (guard hair and underfur) from an area 5 cm in diameter on back region of eight brown bears before winter, and observed the shaved area the following spring. As a result, we found that underfur had grown in the shaved areas on all individuals. Unlike Asiatic black bear (*Ursus thibetanus*), which does not show hair growth during winter, the underfur could be necessary for brown bear inhabiting in sub-arctic region during winter. Maintaining actively the hair cycle in brown bear may be an adaptation to colder environments.

Key words: adaptation, guard hair, underfur, *Ursus arctos*

摘要

ヒグマの体毛（保護毛および下毛）が冬期に成長するか否かを検証するため、秋期に8頭の飼育個体の背部を直径約5cmのサークル状に剃毛し、翌春その部位の観察を行った。その結果、ヒマラヤグマでは冬期に体毛は成長しないとされているが、ヒグマでは下毛の成長が認められ、亜寒帯域に生息する本種にとって下毛の存在は重要であることが示された。ヒグマにおける冬期の毛周期活性の維持は寒冷に対する適応であるかもしれない。

キーワード: 適応, 保護毛, 下毛, *Ursus arctos*

Running head: Hair growth of brown bears

Introduction

Hair growth and replacement have been studied well in companion animals (Diaz et al. 2004) and laboratory rodents (Kuhlmann et al. 2003), but rarely in wild mammals. Photoperiod and temperature are important exogenous factors for mammals, controlling secretion of the melatonin and prolactin that directly influence cyclic activity of hair follicles (Forsyth et al. 1997; Lincoln 1998, 1999; Gebbie et al. 1999; Goldman 2001). Photoperiod and temperature are also important triggers of onset of hibernation or end of hibernation in mammals, such as garden dormouse (*Eliomys*

quercinus) (Pajunene 1983, 1992; Le Gouic et al. 1996; Janicki and Cygan-Szczegieliak 2006; Batavia et al. 2013). Among mammals that hibernate, bears are the largest. Their hibernation is initiated primarily by environmental cues, such as ambient temperature (Evans et al. 2016). During hibernation, metabolism of bears decreases (Watts et al. 1987; Watts and Cuyler 1988; Watts and Jonkel 1988). Therefore, we may expect to find a hypometabolic condition of the bear hair cycle during winter. In fact, Nakashita (2006) reported that the hair (guard hair and underfur) of Asiatic black bears (*Ursus thibetanus*) did not grow from December to May. This physiological characteristic may not be common to all bear species that hibernate, because of environmental differences. Therefore, in the present study, we examined hair growth of brown bears (*Ursus arctos*) from December to May.

Materials and Methods

The experiment was conducted at the Sahoro Resort Bear Mountain, Shintoku, Hokkaido, Japan, located at an altitude of 350 m above sea-level. The Bear Mountain is an outdoor enclosure of brown bears approximately 15 ha in area. In Shintoku, from 2010 to 2014, average temperature and rainfall were 7.1 °C and 1,302 mm, respectively (Shintoku Town 2015). Eleven male brown bears are kept in captivity

in this area. During the day, they moved freely in this area. At night, each bear stayed in its own room. We chose eight individuals for this study. Their biological information is shown in Table 1.

Table 1 Eight male brown bears examined in the present study

Identification symbol	Age on 2014	Weight (kg) on October 2014
a	12	452
b	19	379
c	22	333
d	24	365
e	6	362
f	15	386
g	22	479
h	22	365

On October 25-30, 2014, we immobilized eight brown bears by delivering xylazine and a mixture of zolazepam and tiletamine (Zoletil 100) (Virbac S. A., Carros, France) via blow-dart (Cattet et al. 2003). Based on weight of the bears, we determined the appropriate dosages for each individual: xylazine and Zoletil 100 were prepared at 1 mg/kg and 3 mg/kg, respectively. Then, we shaved off the hair (guard hair and underfur) from an area of 5 cm in diameter on the back region about 60 cm from the ears. To clearly mark the circle, we stained the dark brown hairs around the shaved circle with light brown human hair dye commercially sold. All bears were caged for hibernation from December 14, 2014 to March 5-19, 2015. On April 3-8, 2015, after immobilization, we confirmed whether hair grows within the shaved circle or not. Following methods approved in guidelines on animal experiment of Obihiro University of Agriculture and Veterinary Medicine, we carefully performed this experiment, taking animal welfare into consideration.

Results and Discussion

In the present study, we found that the underfur of all brown bears grew tightly from November to March. The length of new hair was almost similar to that of hair around the saved circle area. Therefore, unlike Asiatic black bear

(Nakashita 2006), the brown bear maintained actively its hair cycle during winter. Nakashita (2006) showed that both guard hair and underfur of the Asiatic black bear did not grow from December to May, but, in the brown bear, only the guard hair did not grow from November to March. In mammals, the underfur plays an important role in insulation against cold (e.g. Soppela et al. 1986; Feldhamer et al. 2015). For instance, in the field vole (*Microtus agrestis*) and the American mink (*Neovison vison*) occurring in northern Eurasia and North America, respectively (Musser and Carleton 2005; Wozencraft 2005), the underfur density of winter coat is higher than that of summer coat (Khateeb and Johnson 1971; Kondo 2000). Therefore, the underfur could be necessary for mammals inhabiting in sub-arctic region during winter. The Asiatic black bear is mainly distributed in temperate areas, but the main distribution of the brown bear is sub-arctic (e.g. Wozencraft 2005). Maintaining actively the hair cycle in brown bear during winter may be an adaptation to colder environments.

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