

Effect of Grazing on Habitat and Behavior of Wild Mammals

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Abstract

Although there are few grassland specialists among terrestrial mammal species (110-115) in Japan, 52 mammal species inhabit Japanese grasslands and 22 of them are listed in the Red Data Book of Japan. However, some grassland mammals, such as the sika deer and the wild boar, cause serious damage to grasslands. The relationship between cattle grazing and wild mammals in Japanese grasslands should be considered within the following two contexts: 1) the conservation of grassland mammals and 2) the control of mammal damage in grasslands. Firstly, the effect of cattle grazing on the habitats of small mammals was considered in the context of the conservation of grassland mammals. The habitat quality for small mammals was high in tall-grass pasture with low grazing intensity but was low in short-grass pasture with high grazing intensity. Therefore, there is a trade-off between the habitat quality for small mammals and the productivity for grazing cattle in the sympatric animal production system. Secondly, the zoning of areas for cattle grazing between wildlife habitats and agricultural areas was considered in order to control wildlife damage in grasslands. In abandoned cultivated land, the introduction of cattle grazing was an effective deterrent to rooting by wild boars, because cattle grazing reduced the food resources and the secure cover for wild boars. However, the intrusion of sika deer into pastures could not be prevented by cattle grazing. The activity of sika deer within a stock farm was affected by the herbage quality and the nearest escape cover. Hence, cattle grazing alone is not sufficient for preventing wildlife damage in grasslands.

Japanese wild mammals in grassland

Japan is a mountainous and forest-dominant country. Mountainous and forested areas cover 61 and 66% of the land, respectively. Grassland covers only 3% of the land area of Japan. Furthermore, Japanese grassland is not a native but a semi-natural grassland maintained by various human activities such as cattle grazing, harvesting and burning (Tsukada et al. 2004a). Therefore, the Japanese mammal fauna reflect these habitat characteristics. Although a total of 52 wild mammal species are listed as inhabitants of grassland in Japan (Tsukada 2007), making up about 42.3% of all terrestrial mammal species (115 species; Abe et al. 2005), only two species, viz. harvest mouse (*Micromys minutus*) and Japanese field vole (*Microtus montebelli*), are grassland specialists and the other species are habitat generalists (Tsukada 2007). Among these grassland mammal species, 22 species (42.3%) are listed in the Japanese Red List (Ministry of the Environment, Japan 2007), and 33 species (63.5%) are ranked as “common” in the Red List of the Mammalogical Society of Japan (Mammalogical Society of Japan 1997). Two grassland specialist species, the harvest mouse and Japanese field vole, are not listed in the Japanese Red List but are listed in 27 and 9 local Red Data Books, respectively. The semi-natural grasslands, which are important habitats for such grassland mammal species, are not stable and have been diminished because the agricultural activities in the grassland have also been abandoned in the course of recent rapid socio-economic changes.

On the other hand, other grassland mammal species have become abundant and caused some serious problems. Among 13 of the medium and large-sized grassland species observed in pastures in Tochigi Prefecture, central Japan (Tsukada et al. 2008a), sika

deer (*Cervus nippon*) and wild boars (*Sus scrofa*) have caused especially serious damage in grasslands. Sika deer graze on herbage stocked for cattle with an economic cost amounting to ¥22.3 billion, which represents 86.8% of the total herbage damage caused by wild mammals in 2008 (MAFF 2009). For example, the amount of herbage damage caused by sika deer was estimated at about 245-359 tons of dry matter within a year at the local farm, Koze Dairy Farm, which encompasses 99.4 ha of grassland (Table 1). In contrast, wild boars have caused damage chiefly by their rooting activity in grasslands, although they also graze on herbage for cattle (Ueda et al. 2008). The wild boar is omnivorous and prefers eating the roots of plants, such as clover and dandelion, and also eats the beetle larvae of Rutelinae. When wild boars forage on these plants and insects, they turn up grass roots (Ide and Nakagami 2009a, b; Fig. 1).

Given the current situation regarding grassland mammals described above, the relationship between cattle grazing and wild mammals in Japanese grasslands should be considered within the following two contexts: 1) the conservation of grassland mammals and 2) the control of mammal damage in grasslands.

With regard to the first context, I will discuss how to manage cattle grazing in accord with the conservation of mammals in grasslands. With regard to the second context, I will examine cattle grazing as a possible management tool for controlling damage by wild mammals.

The conservation of small grassland mammals

Firstly, the effect of cattle grazing on the habitats of small mammals was considered in the context of the conservation of grassland mammals. Tsukada et al. (2004b) investigated the species composition of the small mammal fauna in pastures and its relationship with pasture characteristics in the northern part of Tochigi, Japan. In this study, the species richness of small mammals was high in tall-grass pastures while it was low under high cattle grazing intensity (Fig. 2). This relationship was also observed with respect to the micro habitat features within pastures. The number of large Japanese field mice (*Apodemus speciosus*) increased with an increase in the sward height where the animal was captured. These results suggest that the habitat quality for small mammals is not fully compatible with cattle grazing. When the maximum

Table 1. Herbage damage by sika deer at Kouzu Dairy Farm in Gunma Prefecture, Japan¹.

Year	2007	2008	2009
Amount of herbage damage (DMt)	285	245	359
Cost for damage (¥ Mill.) ²	13.3	11.5	16.8

¹Herbage damage was estimated by the difference in herbage yield between caged and uncaged plots (Tsukada and Ishikawa in preparation)

²The cost was converted at the herbage purchase price (¥46.7/kg)

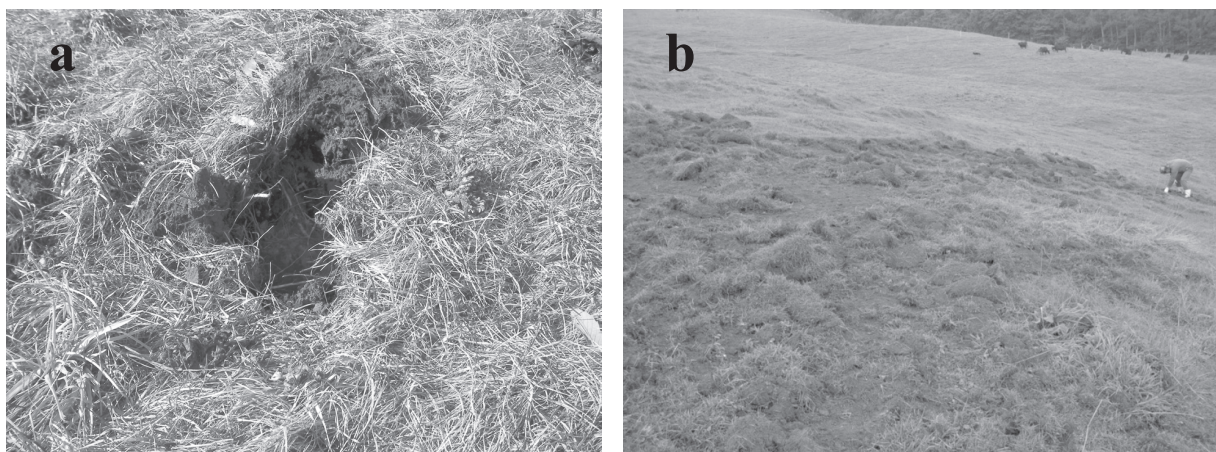


Fig. 1. Two types of rooting activity by wild boars in grasslands. The perforation (a) and exfoliation (b) types of digging.

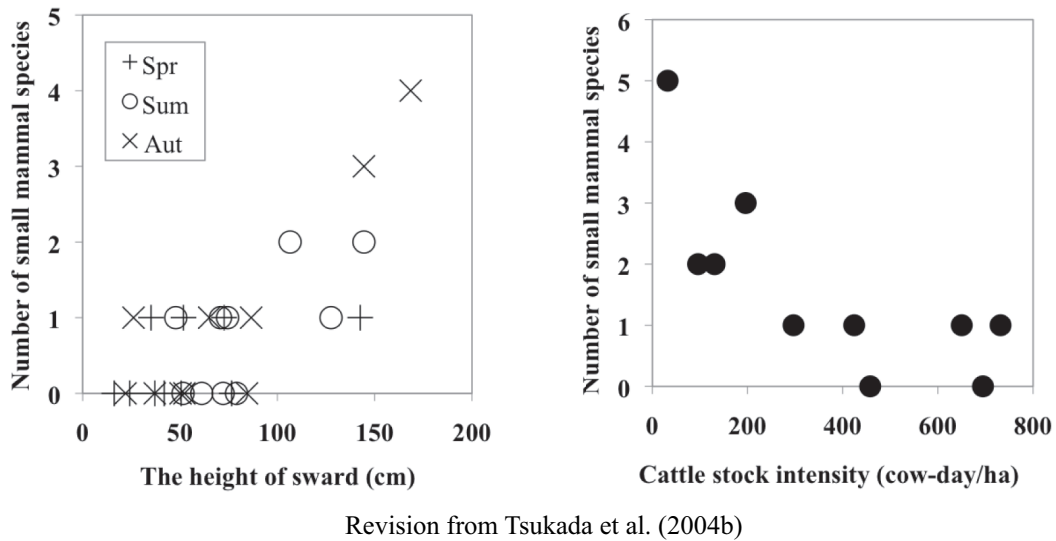


Fig. 2. Relationship between species richness of small mammals and two pasture characteristics: 1) maximum plant height (left) and 2) cattle stock intensity (right).

productivity for cattle grazing is expected, the grazing intensity would become high and the short-grass pasture would be maintained. However, in such situations, the habitat quality for small mammals becomes worse because of the high predation risk. On the other hand, when high habitat quality for small mammals is expected, tall-grass pasture with low grazing intensity becomes dominant, and the productivity for grazing cattle becomes worse. In other words, there is a trade-off between the habitat quality for small mammals and the productivity for grazing cattle in the sympatric animal production system. Therefore, we must carefully consider the trade-offs when the conservation of grassland mammals is considered in a pasture where animal production is conducted con-

currently.

Mammal damage control in grassland

The control of mammal damage to grassland must also be considered. Although many counter measures for controlling mammal damage have been proposed and actually put into practice in grasslands (Tsukada 2009), the application of cattle grazing as a possible management tool for controlling damages inflicted by wild mammals has increased recently in Japan (Senda et al. 2002; Ueda 2003; Arita 2005). The basic concept of this use of cattle grazing is shown in Fig. 3. In this schema, wildlife habitat is mostly located in the mountainous area where pest mammals, such as wild boars, sika deer and Japanese monkeys, are abundant.

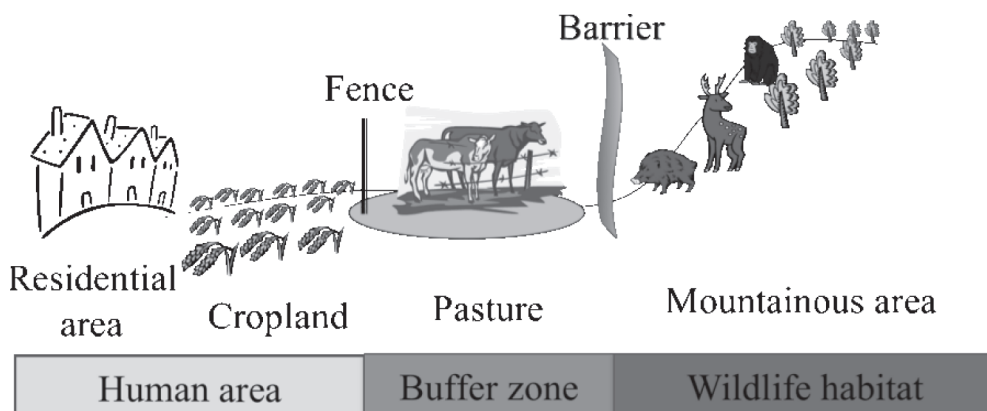


Fig. 3. A schema of the control of wildlife damage by cattle grazing in pasture.

The human areas, including croplands and residential areas, are located adjacent to the mountainous area. The pastures are located just between the human areas and the wildlife habitats. The pasture can be a buffer zone which can prevent pest mammals from intruding into the human area. In fact, in some abandoned cultivated land, the introduction of cattle grazing effectively prevented the infliction of damage by wild boars (Ide 2007). Ide et al. (2005) investigated the rooting activities of wild boars and the main flora in abandoned cultivated land located in the middle of Shimane Prefecture in southwestern Japan before and after the introduction of cattle grazing. Before the introduction of cattle grazing, the abandoned cultivated land was dominantly covered by Japanese plume-grass (*Miscanthus sinensis*) and kudzu-vine (*Pueraria lobata*), and the amount of rooting by wild boars was relatively high (Fig. 4). However, after cattle grazing was introduced in this location in 2000, the Japanese plume-grass and kuzu-vine vanished, and the rooting activity by wild boars decreased dramatically (Fig. 4). These results showed that cattle grazing in abandoned cultivated land had an effect on the habitat and behavior of wild boars. The habitat changes had two aspects. One was that the food resources for wild boars,

such as the root of the kudzu-vine, had decreased. The second change was that the secure places for wild boars, such as bushy Japanese plume-grass, had also disappeared. Because of these habitat changes, the rooting activity of wild boars also decreased after the grazing by cattle was introduced.

The effect of cattle grazing in controlling herbage damage induced by sika deer has been the subject of several studies. Tsukada et al. (2008b) investigated the relationship between the appearance of sika deer and cattle grazing in the pastures on two farms located in Tochigi Prefecture, Japan. The deer activities as estimated by camera trapping did not appear to be affected by the cattle grazing intensities on the pastures of both farms. The captivity study also showed that sika deer first showed various avoidance behaviors in relation to cattle, but became habituated to the cattle after two weeks of exposure to them (Matsumot et al. 2005). In other cases, the appearance of sika deer in a pasture accompanied by grazing cattle was observed in various regions, while the same situation was also observed for wild boars (Fig. 5). On the other hand, deer activity within a boundaries of a farm was clearly affected by pasture utilization, such as pasture renovation. Tsukada et al. (2009) investigated the

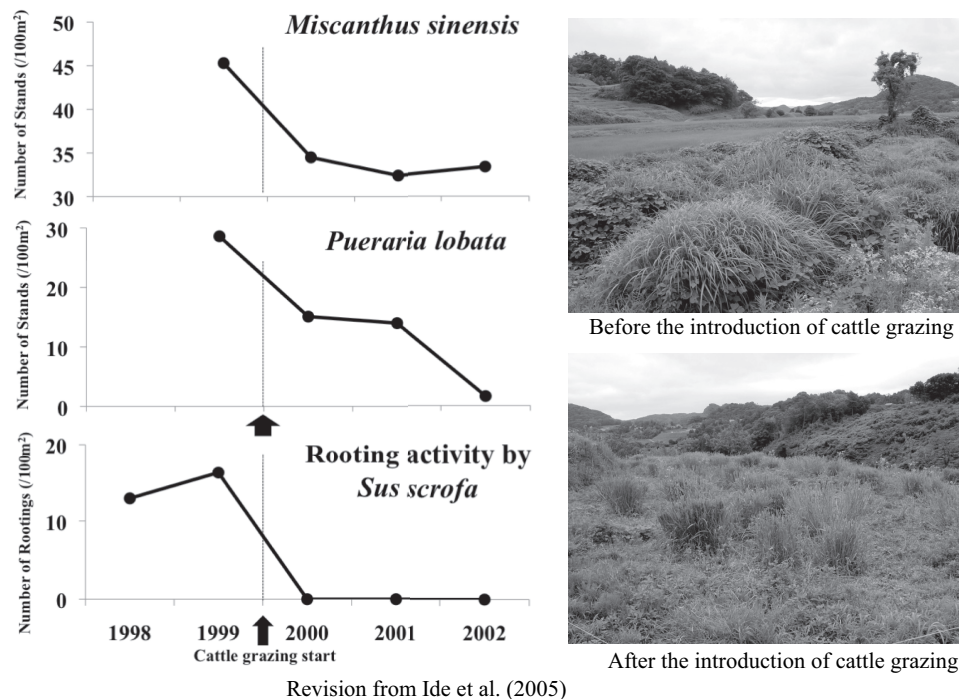


Fig. 4. The change in the rooting activity by wild boars and the main flora on abandoned cultivated land located in the middle of Shimane Prefecture in southwestern Japan before (above photo) and after (below photo) the introduction of cattle grazing. Dr. Ide took these photos.



Fig. 5. The appearance of wild sika deer (left) and wild boars (right) at pastures accompanied by grazing cattle. The left photo was taken at the public pasture located at Izu, Shizuoka, central Japan. The right photo was taken by Ishimoto (National Livestock and Breeding Center) at National Agricultural Research Center for Western Region located at Shimane, western Japan.

activity of sika deer within a farm. They compared the density of deer feces among locations at various distances from the farm periphery. As a result, an extraordinarily high density of deer feces was observed in only one paddock where pasture renovation had been conducted, although the distance from the farm periphery did not affect the density of deer feces. Pasture renovation generally improves the quantity and quality of herbage in a pasture (Hopkins et al. 1990; Lee et al. 2000). Therefore, deer are assumed to forage selectively in renovated pastures. The activity of deer in open areas was also reported to be affected by the distance from secure places (Reynolds 1966; Williamson and Hirth 1985; Takatsuki 1989).

As is described above, although allowing cattle to graze alone is not sufficient to prevent damage by sika deer nor wild boars in grasslands, the behaviors of these wild mammals could be affected and modified through changes in their habitats and food resources due to the effects of cattle grazing.

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References

- Abe, H., N. Ishii, T. Itoo, Y. Kaneko, K. Maeda, S. Miura and M. Yoneda (2005) A Guide to the Mammals of Japan. Tokai University Press, Kanagawa, 206.
- Arita, H. (2005) Abandoned paddy field management: functions of cattle grazing and land use. *Trans. JSIDRE*, 253: 51-58 (in Japanese with English

summary).

- Hopkins, A., J. Gilbry, C. Dibb, P. J. Bowling and P. J. Murray (1990) Response of permanent and reseeded grassland to fertilizer nitrogen. 1. Herbage production and herbage quality. *Grass Forage Sci.*, 45: 43-45.
- Ide, Y. (2007) Effect of cattle grazing on the rooting by wild boars. *Jpn. J. Grass. Sci.*, 53: 59-63 (in Japanese).
- Ide, Y., N. Koyama, Y. Takahashi and H. Kobayashi (2005) Effect of cattle grazing on the rooting by wild boars in abandoned cultivated land. *Bull. WeNARC*, 4: 173-181 (in Japanese with English summary).
- Ide, Y. and K. Nakagami (2009a) Rooting by wild boars in temperate meadow 1. Seasonal occurrence of perforation type rooting and cause of such a digging. *Jpn. J. Grass. Sci.*, 55 (Suppl): 101 (in Japanese).
- Ide, Y. and K. Nakagami (2009b) Rooting by wild boars in temperate meadow 2. Seasonal occurrence of exfoliation type rooting and cause of such a digging. *Jpn. J. Grass. Sci.*, 55 (Suppl): 102 (in Japanese).
- Lee, I. D., H. S. Lee and S. K. Kim (2000) Comparative studies on the DM yield and quality before and after pasture renovation of summer depression damage pasture. *J. Korean Soc. Grass Forage Sci.*, 20: 215-220.
- MAFF (Ministry of Agriculture, Forestry and Fisheries) (2009) The 2008 Situation of Crop Damages by Wildlife. MAFF, Tokyo, Japan. http://www.maff.go.jp.proxy.blastsound.com/j/seisan/tyozyu/higai/h_zyokyo/h20/pdf/100212-a.pdf (date of ac-

- cess: October 18, 2010) (in Japanese)
- Mammalogical Society of Japan (1997) Red Data of Japanese Mammals. T. Kawamichi (Ed.) Bun-ichi Sogo Shuppan, Tokyo, 279 (in Japanese with English list).
- Matsumoto, A, K. Takeda, S. Hayama and K. Ohshima (2005) Avoidance behavior of captive sika deer against the presence of cattle. *Jpn. J. Grass. Sci.*, 50 (Suppl): 400-401 (in Japanese).
- Ministry of the Environment, Japan (2007) Red List of Mammal. Ministry of the Environment, Japan, Tokyo. http://www.env.go.jp/press/file_view.php?serial=9941&hou_id=8648 (date of access: October 26, 2010) (in Japanese).
- Reynolds, H. G. (1966) Use of ponderosa pine forest in Arisona by deer, elk and cattle. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. Research Note RM-63: 1-7.
- Senda, M., Y. Tanimoto and N. Koyama (2002) Grazing system for conservation of rural resources -On the analysis of case studies-. *Misc. Pub. Natl. Agric. Res. Cent.*, 1: 1-74 (in Japanese with English summary).
- Takatsuki S. (1989) Edge effects created by clear-cutting on habitat use by sika deer on Mt. Goyo, northern Honshu, Japan. *Ecol. Res.*, 4: 287-295.
- Tsukada, H. (2007) The feature, current status and conservation issues of wild mammals in Japanese grassland. *Jpn. J. Grass. Sci.*, 53: 52-58 (in Japanese).
- Tsukada, H. (2009) Conservation of wild mammals and the control of wildlife damage. The standards for grassland management -Multifunctionality of grassland. Japan Grassland Agriculture and forage Association, Tokyo, 151-161 (in Japanese).
- Tsukada, H., O. Imura and K. Shi (2004a) Conservation and management of grassland biodiversity in East Asia. S. H. Hong, J. A. Lee, B.S. Ihm, A. Farina, Y. Son, E. S. Kim and J. C. Choe (Eds.) *Ecological Issues in a Changing World: Status, Response and Strategy*. Kluwer Academic Publishers, Netherland, 157-172.
- Tsukada, H., T. Imura, M. Sutoh, T. Kosako and M. Fukasawa (2004b) Small mammal fauna of public pastures in northern Tochigi, Japan. *Grass. Sci.*, 50: 329-335.
- Tsukada, H., M. Fukasawa, T. Kosako, M. Sutoh and T. Imura (2008a) Mammal fauna survey by camera trapping at pastures in Tochigi prefecture, Japan. M. Nashiki, S. Itano, S. Sakanoue, M. Tsutsumi, K. Shimoda and S. Kano (Eds.), *Report on the Grassland Dynamics in Japan (The 7th Report)*, National Institute of Livestock and Grassland Science, Nasushiobara, 110-115.
- Tsukada, H., M. Fukasawa and T. Kosako (2008b) Is cattle grazing an effective deterrent against sika deer (*Cervus nippon*) intrusion into pastures? *Grass. Sci.*, 54: 45-51.
- Tsukada, H., M. Fukasawa, T. Kosako, Y. Nakamura and Y. Hanafusa (2009) Effect of distance from farm periphery on the risk of forage damage by sika deer (*Cervus nippon*). *Grass. Sci.*, 55: 193-199.
- Ueda, E. (2003) Countermeasure for wildlife damage prevention using zoning with cattle grazing. Takahashi, S. (Ed.) *Wild Mammals in Shiga -Coexistence with Human*. Sunrize-Syuppan, Shiga, 132-157 (in Japanese).
- Ueda, H., Y. Takahashi and M. Inoue (2008) Temperate grassland provides winter food for wild boar (*Sus scrofa* L.). *Jpn. J. Grass. Sci.*, 54: 244-248 (in Japanese with English summary).
- Williamson, S. J. and D. H. Hirth (1985) An evaluation of edge use by white-tailed deer. *Wildl. Soc. Bull.*, 13: 252-257.