Notes on Asiatic black bears denning habits in the Misaka Mountains, central Japan

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Abstract: We investigated the denning ecology of 19 (12 males and 7 females) radiocollared Asiatic black bears (*Ursus thibetanus*) from 2001 to 2004 in the Misaka Mountains, central Japan. We approached 14 dens of 5 females on foot. Thirteen dens were located in cavities that formed between the roots of trees growing on the upper edges of landslides or steep inclines, and 1 den was located in a cavity under a rocky ledge. We were unable to access 39 more dens for which we had approximate locations due to a combination of distance from roads, steep terrain, and high shrub densities. All 53 dens we approached or approximately located were on steep slopes. There were few large trees with large cavities in the study area, which may explain why we failed to find any dens in such cavities.

Key words: Asiatic black bear, denning, den site, hibernation, Japan, *Ursus thibetanus*

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Although relatively poorly documented, winter denning is an important aspect of Asiatic black bear (*Ursus thibetanus*) ecology. Denning ecology of American black bears (*Ursus americanus*), the ursid ecologically closest to Asiatic black bears (Schaller et al. 1989, Reid et al. 1991), has been well studied in North America. American black bears are flexible in selecting dens responding to habitat conditions and use a wide variety of den types including excavated ground cavities, ground level tree cavities, elevated tree cavities, rock crevices, brush piles, and man-made structures (e.g., Barnes and Bray 1966, Beecham et al. 1983, LeCount 1983, Hellgren and Vaughan 1989, Weaver and Pelton 1994, Bertram and Vivion 2002).

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Asiatic black bears in Russia and China sometimes prefer dens in tree cavities, but also select dens in rock crevices, natural spaces under roots, and relatively unsheltered ground nests in remote areas where they can escape severe weather, hunting pressure, and forestry activities (Bromlei 1965, Reid et al. 1991, Xu et al. 1994, Seryodkin et al. 2003). The denning ecology of Asiatic black bears in Japan is poorly documented; they have been shown to select a variety of den types including tree cavities, tree roots, rock crevices, and even relatively unsheltered open ground beds, and seem to prefer dens in inaccessible areas where they may escape hunting and forestry pressure (Hazumi 2000, Huygens et al. 2001). A better understanding of Asiatic black bear denning ecology in Japan may have important management implications because den and denning quality may affect whelping, cub rearing, survival, and recruitment.

Study area

The Misaka Mountains are located north of Mt. Fuji, in Yamanashi Prefecture, central Japan (Fig. 1). They are characterized by steep slopes and narrow valleys with elevations ranging from 330 m to 1,792 m (on Mt. Kurodake). Although human depopulation of the more rural parts of the study area continues, numerous residential areas, roads, orchards, and second homes remain. Forests cover about 95% of the study area and are characterized by coniferous plantations of hinoky cypress (*Chamaecyparis obtusa*), larch (*Larix kaempferi*), and Japanese cedar (*Cryptomeria japonica*) (total of 53%), secondary broadleaf forest dominated by Mongolian oak (*Quercus crispula*), Japanese white oak (*Q. serrata*), Japanese red pine (*Pinus densiflora*), and Japanese chestnut (*Castanea crenata*) (total of 38%), and primary broadleaf forest dominated by Japanese beech (*Fagus crenata*) (4%; Miyawaki et al. 1977, Yamanashi Prefecture 1997).

The mean temperature of Kawaguchi Lake (elevation 800 m, south of the Misaka Mountains) is 6–8°C and the annual precipitation is 1,800–2,000 mm (Yamanashi Prefecture 1997). There are 20–30 days with snow cover per year, and it snows and melts several times between the middle of

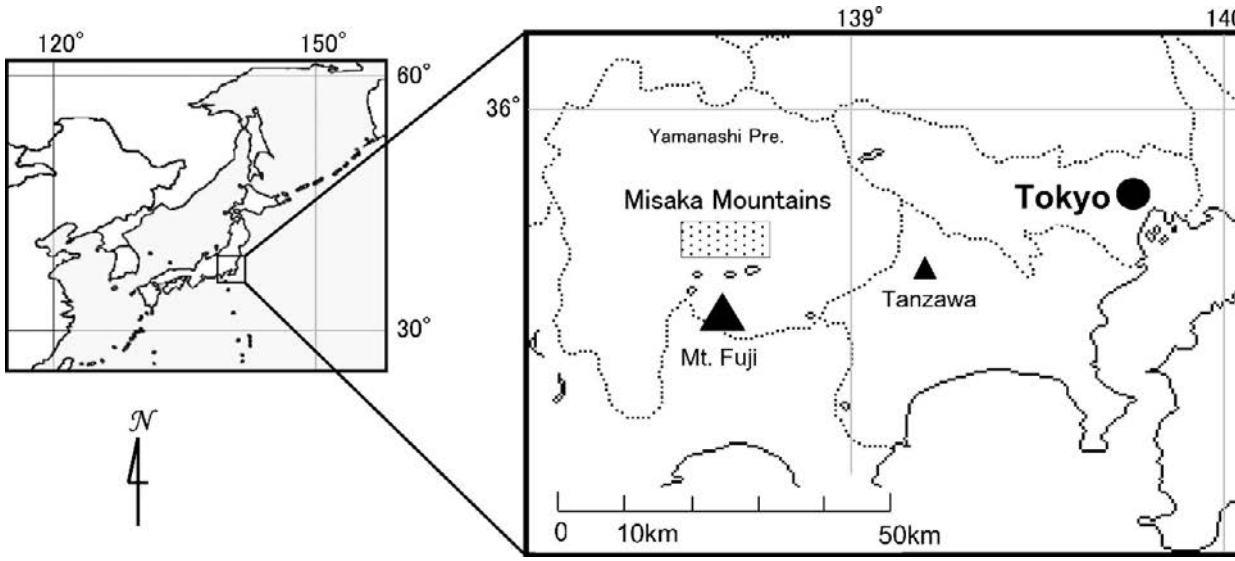

Fig. 1. Study area in Central Japan for 1999–2004 study of denning habits of Asiatic black bears. Dotted area represents the Mikasa Mountains.

December and early March. Bears are distributed throughout the area (Ministry of Environment 2004), and some bears are harvested by hunting or killed as pests every year (Koike, unpublished data).

Methods

We captured bears with barrel traps baited with honey and honeycombs during April–November, 1999 and 2000. Captured bears were anesthetized with a mixture of ketamine hydrochloride (11–13 mg/kg) and xylazine hydrochloride (1.1–1.3 mg/kg), weighed, ear-tagged, radiocollared (Advances Telemetry Systems, Isanti, Minnesota, USA), and tracked weekly from the ground for up to 5 years, except during January and February. Den entry dates were defined as the date midway between the last active location and the first location assumed in the den. Den emergence was defined as the date midway between the last location assumed in the den and the first location away from the den site as determined by direct observation or triangulation. We approached accessible dens carefully on foot so as not to disturb the hibernating bears or the microhabitat surrounding the den sites after the close of the hunting season (15 Feb) to avoid the risk of hunters following our tracks to den sites (Huygens et al. 2001, Hightower et al. 2002). Most dens were not in deep cavities and we observed them from distances of 100–200 m until we visually confirmed through a telescope the presence of a bear. We returned to the dens in the spring after the bears left them to evaluate den structure and microhabitat characteristics. We located the dens with a handheld global positioning system device (eTrex, Garmin, Kansas, USA) and estimated elevation, slope, and aspect using a geographic information system (GIS; ArcView® 3.2, ESRI, Redlands, California, USA).

Results

We radiocollared 19 bears (12 M, 7 F), between April 1999 and October 2000. We visited 14 dens of 5 females during the winters from 1999 to 2004. Two dens were occupied by unique females with cubs, and 1 den was occupied by a female with a yearling (Table 1). We did not document reuse of dens during subsequent winters. We were unable to access an additional 39 dens (16 dens of 8 males and 23 dens of 6 females) due to a combination of steep slopes, dense vegetation, and long distances from access roads. We lost radio contact during winters with an additional 4 males (total of 6 dens).

Of the 14 dens we accessed, 13 were in small cavities which formed from soil erosion between the roots of live trees growing on the edges of landslides

Table 1. Denning chronology of bears in the Misaka Mountains, central Japan, 1999–2004. Values in parentheses indicate number of the den sites that we visited.

	Date	Males	Females
Den entry	mid Nov	1	2
	late Nov	2	12 (6)[a,b]
	early Dec	5	14 (8)[b]
	mid Dec	5	5
	late Dec	3	4
Total		16	37 (14)
Den emergence	mid Mar	2	3 (1)
	late Mar	4	6 (5)[a]
	early Apr	5	8 (3)
	mid Apr	3	8 (3)
	late Apr	2	5
	early May	-	3
	mid May	-	2 (1)[b]
	late May	-	2 (1)[b]
Total		16	37 (14)

[a]One bear was accompanied by a yearling.
[b]One was pregnant.

or on steep slopes; another was in a cavity under a horizontal rock ledge. Den trees included Mongolian oaks (n = 4), Japanese white oaks (n = 3), hornbeams (*Carpinus cordata*, n = 3), firs (*Abies firma*, n = 2), and Japanese chestnut (n = 1). Leaves and stems had been assembled to form a bed in all dens that we were able to enter. Mean den elevation was 1,287 m (SD = 218, range 945–1,558 m). Den sites that we examined were located in broadleaf forests dominated by Japanese beech (n = 5), Japanese chestnut and Mongolian oak (n = 5), and Japanese chestnut and Japanese white oak (n = 4). No den sites were found in coniferous plantations, whereas all den sites (n = 39) we located only approximately were in broadleaf forest.

Timing of den entry was obtained for 53 dens (16 dens of 8 individual males and 37 dens of 7 individual females; Table 1). Females of unknown reproductive status and males entered dens between the middle of November and late December. Females with cubs and a female with a yearling entered dens between late November and early December. Males emerged from dens between the middle of March and late April; females of unknown status emerged between the middle of March and late May. The 2 females with cubs emerged from their dens in mid to late May, whereas the other 12 females we monitored during winter (including one with a yearling) all emerged by mid-April.

Discussion

The majority of bears in our study denned in inaccessible areas, consistent with the findings of other studies in Japan and studies of American black bears (Beecham et al. 1983, LeCount 1983, Schwartz et al. 1987, Huygens et al. 2001). Bears may choose such remote areas to avoid forestry activity and hunting pressure. In Japan, the hunting season for all game species extends from 15 November–15 February. Bears, including females and females with cubs in their dens, possibly den in remote areas because hunters may have selected bears denning in more easily accessible areas. For example, in the Tanzawa Mountains 30 km east of the Misaka Mountains, 63% of radiocollared bears selected den sites in wildlife protection areas or on steep slopes even though such areas represented only about 30% of the study area, possibly to escape hunting pressure (Hazumi et al. 1997, Kanagawa Prefecture 2003). In the Misaka Mountains, wildlife protection areas and temporary game preserves were distributed in a mosaic and occupied only 10% of the area on average from 1999 to 2004 (Yamanashi Prefecture 2004, Koike, unpublished data). Although hunting pressure is reported to be small in this region (Sakamoto 2006), it may still encourage bears to den in remote areas.

None of the 14 dens we found was in a coniferous tree plantation, even though such plantations constituted 53% of the study area. This highlights the importance of broadleaf forests to bears. This importance has been demonstrated repeatedly throughout Japan (e.g., Hanai 1980, Oi and Yamazaki 2006). Forestry activity in the Misaka Mountains continues during winter as there is little snowfall and bears may avoid being disturbed by selecting areas away from plantations.

Although we radiocollared more males than females, we were unable to find the dens of males because males denned deeper in the mountains. Males had significantly larger home ranges (95% kernel method, $\bar{x}$ = 56.4 km^2, SD = 51.3 km^2, n = 23) than females ($\bar{x}$ = 20.7, SD = 18.4 km^2, n = 11; Mann-Whitney test, P = 0.002) and as a result perhaps were more able to travel further to acquire fall foods such as oak acorns or to den (Wildlife Management Office 2002).

Females that gave birth during the winter denned for longer periods than other females or males. Although the sample size is small, these findings are

consistent with other studies (e.g. Bromlei 1965, Smith et al. 1994, Friebe et al. 2001, Haroldson et al. 2002).

We found no dens in tree cavities or under large stumps, whereas such dens were common in Japan in the Nagano and Akita Prefectures (Maita 1996a, Huygens et al. 2001) and in Russia (Bromlei 1965, Seryodkin et al. 2003). Our results are more in line with studies in the Tanzawa Mountains and in Hiroshima prefecture, where a majority of dens were ground dens, either between tree roots like in our study, under fallen logs, in rock cavities, and in unsheltered depressions (Maita 1996b, Hazumi 2000). In our study area, broadleaf forests were harvested for firewood until the 1970s (Yamanashi Prefecture 1997), and remaining broadleaf trees were 40–50 years old (20–40 cm diameter at breast height [dbh]). Coniferous trees in plantations did not exceed 40 years of age (25–30 cm dbh), because these plantations were harvested for their timber. Consequently, there were few large, hollow trees in which bears might have denned in our study area. In contrast, we observed 3 dens of non-radiocollared bears in tree cavities 10 km south of the Misaka Mountains in Aokigahara, a primary beech and Southern Japanese hemlock (*Tsuga sieboldii*) forest with similar climate and snow conditions and with numerous rock cavities due to volcanic activity (Koike, unpublished data). These dens had elevated entrances in live Northern Japanese hemlock (*Tsuga diversifolia*; 134 cm dbh), Nikko fir (*Abies homolepis*; 156 cm dbh), and Mongolian oak (98 cm dbh) trees, and all included bedding material made of *Sasa* spp. stems and leaves.

Small sample size limited the value of our study. It remains important to further document denning and reproductive ecology of Asiatic black bears in Japan because such documentation may have important management implications, especially for the subpopulations listed as threatened by the Ministry of the Environment (Ministry of the Environment 2002).

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Literature cited

BARNES, V.G., JR., AND O.E. BRAY. 1966. Black bears use drainage culverts for winter dens. Journal of Mammalogy 47:712–713.

BEECHAM, J.J., D.G. REYNOLDS, AND M.G. HORNOCKER. 1983. Black bear denning activities and den characteristics in west-central Idaho. International Conference on Bear Research and Management 5:79–86.

BERTRAM, M.R., AND M.T. VIVION. 2002. Black bear monitoring in eastern interior Alaska. Ursus 13:69–77.

BROMLEI, F.G. 1965. Bears of the south far-eastern USSR (medvedi yugo dal'nego vostoka SSSR). Datel'stvo Akademii Nauk SSR, Moskva, USSR. (Translated from Russian, Indian National Scientific Documentation center, New Delhi, India, 1973.)

FRIEBE, A., J.E. SWENSON, AND F. SANDEGREN. 2001. Denning chronology of female brown bears in central Sweden. Ursus 12:37–46.

HANAI, M. 1980. Distribution of the Asiatic black bear. Pages 69–86 in Japan Wildlife Research Center, editors. Second National Survey on the Natural Environment: Distribution of Mammals. Japan Wildlife Research Center, Tokyo, Japan. (In Japanese.)

HAROLDSON, M.A., M.A. TERNENT, K.A. GUNTHER, AND C.C. SCHWARTZ. 2002. Grizzly bear denning chronology and movements in the Greater Yellowstone Ecosystem. Ursus 13:29–37.

HAZUMI, T., M. KOYAMA, K. NAGANAWA, H. TSURUGA. 1997. Asiatic black bear. Pages 453–469 in Kanagawa Prefecture Environment Department, editors. Research Report on the Natural Environment of Tanzawa-Ooyama Mountains. Kanagawa Prefecture, Yokohama, Japan. (In Japanese.)

———. 2000. Bear — from ecological respect. Pages 187–212 in T. Kawamichi, N. Kondo, and T. Morita, editors. Hibernation in mammals. Tokyo University Press, Tokyo, Japan. (In Japanese.)

HELLGREN, E.C., AND M.R. VAUGHAN. 1989. Denning behavior of black bears in a southeastern wetland. Journal of Wildlife Management 53:347–353.

HIGHTOWER, D.A., R.O. WAGNER, AND R.M. PACE, III. 2002. Denning ecology of female American black bears in south central Louisiana. Ursus 13:11–18.

HUYGENS, O., M. GOTO, S. IZUMIYAMA, H. HAYASHI, AND T. YOSHIDA. 2001. Denning ecology of two populations of Asiatic black bears in Nagano prefecture, Japan. Mammalia 65:417–428.

KANAGAWA PREFECTURE. 2003. Sika deer (*Cervus nippon*) management plan in Kanagawa Prefecture. Kanagawa Prefecture, Yokohama, Japan. (In Japanese.)

LECOUNT, A.L. 1983. Denning ecology of black bears in central Arizona. International Conference on Bear Research and Management 5:71–78.

MAITA, K. 1996a. Searching for the bear. Dobutu-sya, Tokyo, Japan. (In Japanese.)

———. 1996b. The method of meeting to bears in the mountain. Yama-Kei Publisher, Tokyo, Japan. (In Japanese.)

MINISTRY OF ENVIRONMENT, EDITOR. 2002. Threatened wildlife of Japan — Red Data Book. Second edition. Volume 1. Mammalia. Japan Wildlife Research Center, Tokyo, Japan. (In Japanese.)

MINISTRY OF ENVIRONMENT. 2004. The national survey on the natural environment report of the distributional survey of Japanese animals (Mammals). Biodiversity center of Japan, Fujiyoshida, Japan. (In Japanese.)

MIYAWAKI, A., K. SUZUKI, K. FUJIWARA, H. HARADA, AND Y. SASAKI. 1977. Vegetation of Yamanashi Prefecture. Yamanashi prefecture, Kofu, Japan. (In Japanese.)

OI, T., AND K. YAMAZAKI. 2006. The status of Asiatic black bears in Japan. Pages 122–133 in Japan Bear Network, editors. Understanding Asian bears to secure their future. Japan Bear Network, Gifu, Japan.

REID, D., M. JIANG, Q.T. TENG, Z. QIN, AND J. HU. 1991. Ecology of the Asiatic black bear (*Ursus thibetanus*) in Sichuan, China. Mammalia 55:221–237.

SAKAMOTO, K. 2006. Seasonal changes of wild boar trail-density distribution in Misaka mountains, Yamanashi Prefecture. Thesis, Tokyo University of Agriculture and Technology, Fuchu, Tokyo, Japan. (In Japanese.)

SCHALLER, G., Q.T. TENG, K.G. JOHNSON, X.M. WANG, H.M. ZHANG, AND J.C. HU. 1989. The feeding ecology of giant pandas and Asiatic black bears in the Tangjiahe reserve, China. Pages 212–241 in J.L. Gittleman, editor. Carnivore behavior, ecology, and evolution. Cornell University Press, Ithaca, New York, USA.

SCHWARTZ, C.C., S.D. MILLER, AND A.W. FRANZMANN. 1987. Denning ecology of three black bear populations in Alaska. International Conference on Bear Research and Management 7:281–291.

SERYODKIN, I.V., A.V. KOSTYRIA, J.M. GOODRICH, D.G. MIQUELLE, E.N. SMIRNOV, L.L. KERLEY, H.B. QUIGLEY, AND M.G. HORNOCKER. 2003. Denning ecology of brown bears and Asiatic black bears in the Russian Far East. Ursus 14:153–161.

SMITH, M.E., J.L. HECHTEL, AND E.H. FOLLMANN. 1994. Black bear denning ecology in interior Alaska. International Conference on Bear Research and Management 9(1):513–522.

WEAVER, K.M., AND M.R. PELTON. 1994. Denning ecology of black bears in the Tensas river basin of Louisiana. International Conference on Bear Research and Management 9(1):427–433.

WILDLIFE MANAGEMENT OFFICE. 2002. Ecological survey of Asiatic Black Bears. Pages 82–109 in Wildlife Management Office and Ministry of Environment, editors. Report of the nature restoration techniques. Wildlife Management Office, Kawasaki, Japan. (In Japanese.)

XU, L., Y.Q. MA, Z.X. GAO, AND F.Y. LIU. 1994. Characteristics of dens and selection of denning habitat for bears in the South Xiaoxinganling Mountains, China. International Conference on Bear Research and Management 9(1):357–362.

YAMANASHI PREFECTURE. 1997. Yamanashi Prefecture Forest — The fifth management plan. Yamanashi Prefecture, Kofu, Japan. (In Japanese.)

———. 2004. A map of wildlife protection area in Yamanashi Prefecture. Yamanashi Prefecture, Kofu, Japan. (In Japanese.)

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