MOVEMENTS AND HABITAT USE OF JAPANESE BLACK BEARS IN NIKKO

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The Japanese black bear (*Selenarctos thibetanus*) population has declined throughout Japan. Intensive land uses such as forestry, agriculture, and energy development have destroyed their habitat in many areas. More than 2,000 bears are harvested annually, including nuisance kills and sport hunting; however, no bear management policy has been developed or implemented. Sound ecological information is needed so we can develop such a policy.

Since 1978 we have studied the ecology of Japanese black bears in Nikko, central Honshu, and reported on home range size and structure (Hazumi and Maruyama, in press). In this paper we show their movement pattern and habitat use, especially in relation to oak (*Quercus mongolica* var. *grosserrata*) acorn crops, the most important food for these bears.

STUDY AREA

The 100-km^2 study area is located in Nikko, Tochigi Prefecture, central Honshu. Elevations range 800–2,140 m. The climate of Outer Nikko, the eastern half of the area, is dominated by the Pacific Ocean. Summer rainfall is abundant and winter snow scarce. The climate of Inner Nikko is dominated by the Japan Sea. This area is characterized by 240 cm of annual rainfall and snow accumulations of more than 1 m are common between late November and March.

The topography varies from relatively flat, gentle terrain to steep and mountainous. The subalpine zone above 1,700 m is dominated by hemlock (*Tsuga diversifolia*), fir (*Abies mariesii*), and birch (*Betula ermanii*). The montane zone below 1,700 m is dominated by conifer plantations of larch (*Larix leptolepis*), cryptomeria (*Cryptomeria japonica*), and Japanese cedar (*Chamaecyparis obtusa*). Natural forests of oak, beech (*Fagus crenata*), and other deciduous trees occur in patches along valleys below 1,700 m.

METHODS

Eleven bears were captured between 1978 and 1984 (Table 1). They were immobilized with a ketamine hydrochloride and xylazine hydrochloride mixture and fitted with radiocollars. Bears were monitored using stationary yagi and mobile antennas.

Connecting lines between the outermost radiolocations of these bears define the core polygon area. Habitat use was determined by comparing the frequency of radiolocations in several vegetation types in the polygon area with the relative availability of that type. A chi-square test was used to analyze these data.

Acorn production was measured in 28 oak stands. The crops were ranked as follows: 0 = no acorns; 1 = poor crop; 2 = fair crop; and 3 = abundant acorns. The field signs of bears, such as tracks, scats, and claw marks on trees, were also counted in these oak stands each fall.

RESULTS AND DISCUSSION

Five adult male, 3 adult female, 2 subadult males, and 1 male cub black bears were captured, radiocollared, and monitored between 1978 and 1984 (Table 1). Bear 8, an adult male, was monitored for 2 years, and 287 radiolocations were obtained. For all other bears, the number of locations was insufficient to determine annual ranges. Nevertheless, such information is valuable to determine gross seasonal and temporal movements.

Seasonal elevational movements are shown in Figure 1. In April, bear 8 descended from a den at 2,000 m in the subalpine zone to the snow-free montane zone at about 1,300 m, where he remained until May. He then moved upslope following snow melt and plant development in June and reached the upper subalpine zone at 1,800 m in July. Bear 8 began to descend in August and stayed in the montane zone at 1,200 m during September and October. In November, he searched for and found a den site in the subalpine zone.

The other 10 bears showed a somewhat different movement pattern from that of bear 8. They generally remained at 1,100-1,500 m throughout the active season; however, they denned in the subalpine zone, similar to bear 8.

The habitat polygon determined by connecting the

Table 1. Summary of black bears trapped, instrumented, and monitored in Nikko, 1978–84.

Bear	Age	Sex	Tracking periods	Number of locations
1	Ad	M	11 Jul 1978–14 Aug 1978 25 Jul 1983–24 Oct 1983	108
2	Ad	F	8 Jul 1978–18 Jul 1978 19 Jun 1979 (obs.) 10 Aug 1980–19 Aug 1980	32
3	Ad	F	26 Oct 1980–11 May 1981	24
4	Cub	M	26 Oct 1980–12 Dec 1981	23
5	Ad	M	27 May 1981–11 Jun 1981 12 Aug 1982–25 Sep 1982 8 Jun 1983 (obs.)	11
6	Subad	M	20 Jul 1981–6 Nov 1981 15 Jul 1982–20 Jul 1982	48
7	Ad	F	15 Jul 1982–29 Nov 1982	19
8	Ad	M	9 Sep 1982–19 Jul 1984	287
9	Ad	M	5 Sep 1983–3 May 1984	83
10	Ad	M	21 Nov 1983–6 Jun 1984	26
11	Subad	M	21 Nov 1983–9 Aug 1984	24

outermost locations of the 11 bears consisted of 68 km^2 of the montane and subalpine zones and included 5 vegetation types: (I) subalpine evergreen conifer forest, (II) deciduous mountain forests, (III) Japanese larch plantations, (IV) Japanese red cedar and hinoki cypress plantations, and (V) natural bare land. Subalpine evergreen conifer forest dominated 41.3% of the area, followed by Japanese larch plantations and deciduous mountain forests (Table 2).

We compared the proportionate availability and use of the vegetation types to determine habitat preference patterns. Deciduous mountain forests were preferred during the spring, summer, and fall (Table 2). Subalpine evergreen conifer forests were clearly avoided throughout the year. Other vegetation types were used in proportion to their availability (Table 2).

Except for bear 8, this habitat use pattern corresponds well to the summer elevational movements of our instrumented bears. Because of the dense canopy in the subalpine evergreen conifer forest, food availability on the forest floor is very low. Food availability is much higher in the more open-canopy deciduous mountain forests. These forest floors are covered with grasses, forbs, nuts, and berries used by bears.

Acorns are the most important bear food in Nikko (Hazumi et al., unpubl. data). Oak stands were located at 800–1,600 m in the study area. Fall movements of instrumented bears to the montane areas was a result of their seeking acorns. The acorn crop in this area fluctuated annually (Table 3). The crop was large in 1980 but was greatly reduced from 1981 to 1983, and no crop was produced in 1984. The amount of bear sign found in oak stands was directly related to the acorn crop. In 1980, bear sign was concentrated in highly productive stands, but bears

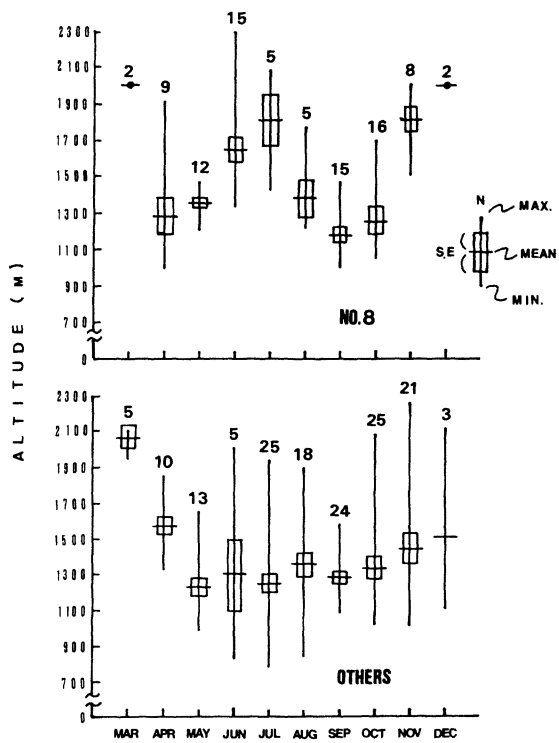

Fig. 1. Elevational movements of 11 black bears in Nikko, 1978–84. The movements of an adult male, bear 8, is shown above; those of other bears are shown below.

Table 2. Comparison of radiolocations and vegetation type availability for 11 black bears in Nikko, 1978–84.

Vegetation types[a]	Area (%)	Number of radio-locations			
		O[b]	E[c]	O/E	*P*
Spring					
I	41.3	8	17.3	0.46	$0.05 > P > 0.025$[d]
II	22.6	23	9.5	2.42	$P > 0.005$[d]
III	25.1	10	10.5	0.95	$P > 0.05$
IV	5.3	0	2.2	0.00	$P > 0.05$
V	5.7	1	2.4	0.42	$P > 0.05$
Summer					
I	41.3	15	32.2	0.47	$P < 0.005$[d]
II	22.6	30	17.6	1.70	$0.05 > P > 0.025$[d]
III	25.1	27	19.6	1.38	$P > 0.05$
IV	5.3	5	4.1	1.22	$P > 0.05$
V	5.7	1	4.4	0.23	$P > 0.05$
Fall					
I	41.3	16	47.9	0.33	$P < 0.005$[d]
II	22.6	70	26.2	2.67	$P < 0.005$[d]
III	25.1	26	29.1	0.89	$P > 0.05$
IV	5.3	0	6.1	0.00	$0.025 > P > 0.01$[d]
V	5.7	4	6.6	0.61	$P > 0.05$

[a] See text for vegetation types.
[b] O = observed value.
[c] E = expected value.
[d] Difference between observed and expected is significant.

Table 3. Acorn production and frequency of bear sign in 28 oak stands in Nikko, 1980–84.

Year	Crop rank[a]	No. of stands	No. field signs per stand ($\bar{x} \pm$ SD)	Rank value of crop per stand ($\bar{x} \pm$ SD)
1980[b]	0	0	—	
	1	7	0.42 ± 0.79	1.74 ± 0.65
	2	10	2.82 ± 3.32	
	3	2	7.50	
1981	0	22	2.45 ± 3.50	
	1	6	61.33 ± 26.27	0.21 ± 0.42
	2	0	—	
	3	0	—	
1982	0	22	2.95 ± 3.54	
	1	6	28.50 ± 38.78	0.21 ± 0.42
	2	0	—	
	3	0	—	
1983	0	19	0.73 ± 1.94	
	1	9	17.00 ± 22.96	0.32 ± 0.48
	2	0	—	
	3	0	—	
1984	0	28	1.20 ± 5.21	
	1	0	—	0
	2	0	—	
	3	0	—	

[a] 0 = no crop; 1 = poor crop; 2 = fair crop; 3 = abundant acorns.
[b] Nine stands in Inner Nikko were not sampled in 1980.

Table 4. Den site characteristics of black bears and their dates of entry and emergence in Nikko, 1980–84.

Den no.	Bear no.	Elev. (m)	Slope aspect	Entry date	Emergence date
1	3	2,100	NNE	early Dec 1980	?
	4				
2	7	2,020	WSW	late Nov 1982	?
3	8	2,000	N	late Nov 1982	late Apr 1983
4	8	2,000	SW	late Nov 1983	late Apr 1984
5	9	2,250	W	late Nov 1983	late Apr 1984
6	10	1,950	NNE	late Nov 1983	late Apr 1984
7	11	1,970	NNE	late Nov 1983	late Apr 1984

[a] All dens were located in *Abies mariesii* forests.

were much more concentrated in the few stands that produced acorns in 1981–83. In a good acorn year, the bears need not concentrate in particular stands because the crop was widely distributed. During poor acorn years, however, bears concentrated in the few stands where acorns were still available. When the crop failed entirely, little evidence of bear activity was found in oak stands. Furthermore, we lost contact with the bears because they moved from their usual ranges, presumably in search of alternate foods.

Japanese black bear habitat use was synchronous with the phenological development of foods. The variability of acorn production affected habitat use, movement, and local density of bears. Similar movements in response to food availability were reported for black bears (*Ursus americanus*) (Amstrup and Beecham 1976, Garshelis and Pelton 1981) and grizzly bears (*U. arctos*) (Craighead 1976, Servheen 1983) in North America. Jonkel and Cowan (1971) reported a direct correlation between black bear reproductive success and huckleberry (*Vaccinium globulare*) production in Montana. Rogers (1976) reported that poor acorn crops caused a reproductive failure of undernourished black bears in Minnesota.

Radio-collared bears led us to 7 winter den sites (Table 4). Den sites ranged 1,950–2,250 m and were located in the subalpine zone fir forests on aspects where snow accumulations of 1 m or more were common. Den entrance aspect ranged from NNE to N to W to SW. A female and her male cub, bears 3 and 4, denned together during 1980–81. Though natural caves were common at lower elevations, the steep, high-elevation areas were selected as den sites. Important factors for den site selection may be the thermal stability, greater snow accumulation, and lack of human disturbance offered by such sites. This situation is similar to that of grizzly bears (Craighead and Craighead 1972, Vroom et al. 1980) and black bears (Jonkel and Cowan 1971, Novick et al. 1981) in North America.

In Japan, most bear habitats are rapidly shrinking, resulting in a very patchy environment. An acorn crop failure may mean no alternative foods will be available during this critical time; subsequent efforts to seek food often cause bears to damage agricultural crops. This invariably increases the number of nuisance kills, as reported in Tennessee (Beeman and Pelton 1980). Therefore, human encroachment on bear habitat is leading to a critical situation. The major problems for bear management in Japan are to conserve adequate natural montane forests that supply foods and to control hunting pressure.

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LITERATURE CITED

AMSTRUP, S. C., AND J. J. BEECHAM. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wildl. Manage. 40:340–348.

BEEMAN, L. E., AND M. R. PELTON. 1980. Seasonal foods and feeding ecology of black bears in the Smoky Mountains. Int. Conf. Bear Res. and Manage. 4:141–147.

CRAIGHEAD, F. C. 1976. Grizzly bear ranges and movement as determined by radiotracking. Int. Conf. Bear Res. and Manage. 3:97–109.

——, AND J. J. CRAIGHEAD. 1972. Grizzly bear prehibernation and denning activities as determined by radiotracking. Wildl. Monogr. 32. 35pp.

GARSHELIS, D. L., AND M. R. PELTON. 1981. Movements of black bears in the Great Smoky Mountains National Park. J. Wildl. Manage. 45:912–925.

HAZUMI, T., AND N. MARUYAMA. in press. Movements and home ranges of Japanese black bears in Nikko. Int. Conf. Bear Res. and Manage. 6:

JONKEL, C. J., AND I. MCT. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27. 57pp.

NOVICK, H. J., J. M. SIPEREK, AND G. R. STEWART. 1981. Denning characteristics of eight black bears, *Ursus americanus,* in the San Bernardino Mountains of southern California. Calif. Fish and Game 67:52–61.

REYNOLDS, D. G., AND J. J. BEECHAM. 1980. Home range activities and reproduction of black bears in west-central Idaho. Int. Conf. Bear Res. and Manage. 4:181–190.

ROGERS, L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. North Amer. Wildl. and Nat. Resour. Conf. 41:431–438.

SERVHEEN, C. W. 1983. Grizzly bear food habits, movements, and habitat selection in the Mission Mountains, Montana. J. Wildl. Manage. 47:1026–1035.

VROOM, G. W., S. HERRERO, AND R. T. OGILVIE. 1980. The ecology of winter den sites of grizzly bears in Banff National Park, Alberta. Int. Conf. Bear Res. and Manage. 4:321–330.