

USE OF STONE PINE SEEDS AND OAK ACORNS BY ASIATIC BLACK BEARS IN CENTRAL JAPAN

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Abstract: Korean and Japanese stone pines (*Pinus koraiensis* and *P. pumila*, respectively) occur in Japan. Although the importance of stone pine seeds to bears (*Ursus* spp.) is well documented, the use of stone pine seeds by Asiatic black bears (*U. thibetanus*) in Japan has not been reported. We observed use of Korean and Japanese stone pine seeds by Asiatic black bears in the Northern Japanese Alps of central Japan. We found 15 scats composed mostly or entirely of the remains of Korean stone pine seeds, 27 Korean stone pines with bear claw marks up their trunks, and branches broken by bears at the tops of 3 of these trees. Two radiocollared adult females, regularly located in areas where sign of feeding on Korean stone pine seeds occurred, moved down to the upper montane zone and apparently fed on acorns of Mongolian oak (*Quercus crispula*) after those matured. Three radiocollared adult males using the same drainage started feeding on acorns of Mongolian oak in the lower montane zone at an earlier date. We hypothesize that bears in the study area prefer acorns to Korean stone pine seeds and that males congregate in prime feeding areas at lower elevations to start feeding on acorns earlier in the season than females. We also found 4 scats composed of 1–25% Japanese stone pine seeds and 1 scat containing traces of Japanese stone pine seeds in the alpine zone.

Ursus 12:47–50

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Five species of stone pines occur worldwide, 2 of which, the Korean and Japanese stone pines, occur in Japan (Schmidt 1994). Mattson and Jonkel (1990) reported the importance of stone pine seeds to bears in many regions where bear and stone pine distributions overlap. In the United States of America (USA), American black bears (*Ursus americanus*) and especially grizzly bears (*U. arctos horribilis*) depend on whitebark pine (*P. albicaulis*) seeds. Some bears eat virtually nothing else in good seed crop years, and when seed crops are small, nuisance bear activity dramatically increases (Kendall 1983, Mattson et al. 1991, 1992; Mattson and Reinhart 1994). A similar relationship exists between brown bears (*U. arctos*) and stone pine seed crops in Siberia (Stroganov 1962, Ustinov 1965 cited by Mattson and Jonkel 1990).

In the Russian Far East, Asiatic black bears heavily use Korean stone pine-broad leaved forests, and Korean stone pine seeds are an important food (Stroganov 1962, Bromlei 1965, Kucherenko 1973 cited by Yudin 1993). On Hokkaido Island, Japan, Ohdachi and Aoi (1987) reported the use of Japanese stone pine seeds by brown bears (*U. a. yesoensis*). The use of stone pine seeds by Asiatic black bears in Japan has not been reported.

STUDY AREA AND METHODS

The approximately 650 km² study area (36°22'N, 137°45'E) encompasses the southeastern end of the Northern Japanese Alps in Nagano prefecture and is bordered by the Matsumoto Plain on the East. Three vegetation zones occurred in the study area: the montane zone at elevations between 700 m and 1500 m where typical woody genera included *Quercus*, *Castanea*, *Juglans*, *Magnolia*,

Aesculus, *Tilia*, *Cercidiphyllum*, *Prunus*, *Pterocarya*, *Acer*, *Alnus*, *Betula*, *Carpinus*, *Cornus*, *Sorbus*, *Pinus*, *Thuja*, *Tsuga*, *Hydrangea*, *Ilex*, *Rhus*, and *Viburnum*; the subalpine zone between 1500 m and 2500 m where typical woody genera included *Abies*, *Picea*, *Tsuga*, *Pinus*, *Thuja*, *Chamaecyparis*, *Betula*, *Viburnum*, *Sorbus*, *Salix*, and *Alnus*; and the alpine zone above 2500 m, where typical woody genera included *Pinus*, *Acer*, *Alnus*, and *Sorbus*. Most of the steeper slopes in the study area had been selectively logged, and the gentler slopes had been clearcut and converted to plantations usually of larch (*Larix kaempferi*), Japanese red pine (*Pinus densiflora*), or hinoki cypress (*Chamaecyparis obtusa*). The shrub layer of the montane and lower subalpine zones was characterized by widespread and dense thickets of dwarf bamboo (*Sasa* spp.). Although not common, Korean stone pines occurred in some valleys of the montane and subalpine zones. Japanese stone pines, a creeping pine, occurred in dense and widespread thickets above timber line in the alpine zone. Mongolian oak, Japanese white oak (*Q. serrata*), Japanese chestnut (*Castanea crenata*), and a walnut (*Juglans mandshurica*) were common hard-mast producing trees throughout the montane zone of the study area.

The data presented in this paper were obtained incidentally to studies of bear home range and food habits. Asiatic black bears were captured with barrel traps between August 1995 and October 1997. Bears were fitted with either Lotek (Newmarket, Ontario, Canada) or Advanced Telemetry Systems (Isanti, Minnesota, USA) radiocollars, and released; attempts were made to track them from the ground at 3–4 day intervals with handheld Yagi antennas from September 1995 to December 1997. We collected scats from September 1995 to November 1999. Scats were

softened in water and washed through 3 sieves (apertures of 4, 2.36, and 0.5 mm) to separate individual food items. The relative volume of each food item was visually estimated and assigned to 1 of 6 categories: trace, 1–25%, 25–50%, 50–75%, 75–100%, and 100%.

RESULTS

We captured 22 Asiatic black bears (14 males, 8 females), of which 9 (5 males, 4 females) are relevant to this paper (i.e. they roamed in areas with Korean or Japanese stone pines). Seven bears (4 males, 3 females) used a drainage with an abundant crop of Korean stone pine cones in early fall 1997. Nine bears (5 males, 4 females) used the alpine zone during summers 1996 and 1997 and thereby had access to Japanese stone pine seeds. We found 408 scats from September 1995 to November 1999, of which 117 are relevant to this paper (i.e., we found them in areas with Korean or Japanese stone pines).

Use of Korean Stone Pine Seeds.—We located 2 radiocollared adult females (bears 1 and 2) regularly in the lower subalpine zone during 12–30 September 1997, in an area where Korean stone pines occur. During 2 approximately 3-hour searches in this area, we found (1) 27 Korean stone pines with claw marks up their trunks, (2) branches broken by bears at the top of 3 of 5 trees we climbed, and (3) 14 scats composed entirely and 1 scat composed mostly (50–75%) of pine seed remains (the remaining 25–50% consisted of seeds of *Aralia cordata*). We found these scats on 2 opposite slopes, and 9 of them were in 2 clusters, 1 of which was near an obvious day bed. Bears 1 and 2 moved to lower elevations after 25 and 30 September, respectively. We did not gather scats at these lower elevations, but we observed numerous “enza” (conspicuous clusters of branches broken by bears when they reach for mast at the top of trees) in Mongolian oaks, which were abundant. An excellent acorn crop was produced in fall 1997 (O.C. Huygens, personal observations). Bears 1 and 2 stayed at these lower elevations until at least 1 and 27 November, respectively.

We did not obtain reliable locations during the first half of September for the 3 large males (bears 3, 4, and 5) that used the same drainage as bears 1 and 2. However, from 18 September (bears 3 and 4) and 19 September (bear 5), the males congregated in the lower montane zone, where they possibly excluded other bears (Huygens 1998). We found 10 scats composed entirely and 1 scat composed of 75–100% acorns from Mongolian or Japanese white oak in this area in fall 1997. Fifty of 54 scats found there in fall 1995 ($n = 12$) and 1996 ($n = 42$) consisted of 100% acorns from Mongolian or Japanese white oak, further indicating that in the fall bears in this area fed mainly on

oak acorns (non-acorn items of scats found in this area in fall 1995–97 included remains of walnuts, *Vespa similina*, Bibionidae spp. pupae, and seeds of *Ilex macropoda* and *Actinidia arguta*).

Although female bears 1 and 2 moved to lower elevations at the end of September, they either remained at higher elevations than males 3, 4, and 5, or mostly avoided the area occupied by them. A young radiocollared male (bear 6) and a radiocollared female (bear 7) also present in this drainage similarly stayed at elevations higher than those of males 3, 4, and 5. We regularly located bears 6 and 7 in areas near both Korean stone pines and Mongolian oaks during fall 1997, but we could not document their feeding habits because steep terrain and dense dwarf bamboo undergrowth made finding scats and field sign difficult.

The only year of the study with a good Korean stone pine cone crop was 1997; there were good oak acorn crops 1995–98 and a bad acorn crop in 1999 (O.C. Huygens, personal observations). We found no bear signs in areas with Korean stone pines in fall 1998 and 1999. Oak acorns remained the major fall food for bears during all years (O.C. Huygens, unpublished data).

Use of Japanese Stone Pine Seeds.—We regularly located 9 radiocollared bears (bears 1 through 9) in or near the alpine zone, summer 1996 and 1997. Japanese stone pine thickets are virtually impenetrable, and we did not search them for bear scats. However, from September 1995 to September 1999 we found 37 scats in the alpine zone on trails ($n = 5$), in alpine meadows ($n = 3$), and near 2 alpine lodges where bears were attracted by anthropogenic foods ($n = 29$). Of these, 4 contained 1–25% and 1 contained traces of the remains of Japanese stone pine seed. Other food items included *Rubus* spp. berries, *Sasa* spp. leaves, and stems and leaves of various forbs.

DISCUSSION

American black bear males selected the best feeding areas, and females then tended to avoid those areas in Montana (Jonkel and Cowan 1971) and in Tennessee (Garshelis and Pelton 1981). Similar behavior possibly took place in our study. We hypothesize that (1) bears in our study area prefer oak acorns to Korean stone pine seeds; (2) in years of large pine seed and acorn crops, pine seeds mature and become available to bears earlier than acorns; (3) in such years bears feed on pine seeds until the acorns mature; (4) in the early fall, large males congregate in prime feeding areas in the lower montane zone and possibly exclude other bears; and (5) because of this exclusion, females and younger males forage on foods such as pine seeds at higher elevations until increased

abundance of acorns allows them to move to lower elevations.

Further studies are required to test these hypotheses. In particular, studies should determine whether bears prefer acorns over stone pine seeds, measure the nutritional values to bears of acorns and stone pine seeds in the study area, and document the energy expended by bears to forage on stone pine seeds versus acorns.

We did not witness use of sciurid pine cone caches by bears in our study area. In the Yellowstone area of the USA bears efficiently fed on stone pine seeds by raiding cone caches made by red squirrels (*Tamiasciurus hudsonicus*; Kendall 1983; Mattson and Reinhart 1994, 1997). In Siberia, brown bears use stone pine cones cached by Siberian chipmunks (*Eutamias sibiricus*; Novikov 1956, Stroganov 1962, Bromlei 1965, Ustinov 1976). Red squirrels (*Sciurus vulgaris*) were seen handling stone pine cones in the study area, but we made no efforts to observe caching behavior. Red squirrels cached Korean stone pine seeds on Hokkaido Island (Miyaki 1987, Hayashida 1989) and in China (Hutchins et al. 1996), but caches consisted of only 2–4 seeds (range 1–12). It is unlikely that bears could make efficient use of such small caches.

Korean and Japanese stone pines are not widely distributed in Japan and produce irregular seed crops. However, further study of the use of stone pine seeds by Asiatic black bears is important because pine seeds are potentially a valuable bear food, especially in years when acorn crops fail. The relationship between bears, acorns, and stone pine seeds might also have important management implications in the Korean peninsula, in eastern Manchuria, and in southeastern Siberia, where Korean stone pines are common, where they often grow in association with hardwood species including Mongolian oak, and where they are one of the most sought-after lumber species (Stroganov 1962, Bromlei 1965, Yudin 1993, Luo 1994, Schmidt 1994, Hutchins et al. 1996).

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