

IMPACT OF HUMAN ACTIVITIES ON SURVIVAL OF THE JAPANESE BLACK BEAR

SHIGERU AZUMA, Primate Research Institute, Kyoto University, Inuyama, Aichi, Japan 484
HARUMI TORII, Shizuoka Forestry Experiment Station, Hamakita, Shizuoka, Japan 434

Abstract: The range of the Japanese subspecies of the Himalayan black bear (*Selenarctos thibetanus japonicus*) has declined in western Honshu. In Kyushu and Shikoku, local populations are approaching extinction. Meanwhile, the annual harvest of bears has increased from less than 1,000 to over 2,000 between 1950 and 1972, largely resulting from the increasing number of control kills. The distribution dynamics and the ecological consequences of the impact of human activities on 4 subpopulations were studied. Reductions in bear range and outbreaks of tree damage by bears were found closely associated with the rapid disappearance of natural forest. Present control practices and the various types of habitat destruction made these subpopulations increasingly vulnerable, and in 2 cases, partial or complete elimination of a subpopulation was confirmed.

Japanese forms of the Himalayan black bear are found on the islands of Kyushu, Shikoku, and Honshu. A form of the Asiatic brown bear (*Ursus arctos yesoensis*) occurs on Hokkaido.

The original habitat of the black bear in central Japan is believed to have extended from subalpine coniferous forests at elevations of 1,500-2,300 m to warm-temperate evergreen broad-leaved forests that ranged from the coast to low-altitude slopes up to 500 m elevation. Forests in the warm-temperate zone have long been exploited and are now largely destroyed. The range of the Himalayan black bear was progressively reduced and became confined to mountainous areas in the cool-temperate (500-1,500 m) and subalpine zones at medium to high elevations. This situation remained fairly stable until the early 1950s.

Large-scale exploitation and destruction of natural forests in the cool-temperate and subalpine zones began in the late 1950s. Bear damage to conifer regeneration has apparently increased since 1970 (Watanabe 1974). As a counter measure, bears were classified as a verminous species and trapping and killing have been encouraged by the government. The status of this species, the largest land carnivore in Japan, must be kept under rigorous scrutiny in view of the critical circumstances stated above.

Records of the total number of bears killed annually in each prefecture and of timber and agricultural damage by bears are available from the Environmental Agency and the Forestry Agency, respectively. However, the records are too meager for critical evaluation of the changing population status and of the consequences of recent human actions. Studies of the combined effect of habitat changes and hunting pressures are exceedingly scarce, and thus the present status of black bears is not well understood.

Takahashi (1974), Watanabe and Komiyama (1976), and others have expressed grave concern over the risk involved in present land-use and forestry practices,

which threaten the survival of black bears. The aim of this paper is to present interim results of studies of 2 subpopulations in central Japan and a literature review of the status of 2 subpopulations in western Japan, which may be informative and may help us to evaluate the impact of present policies on the bear population.

Sincere appreciation is due K. Imanishi, former president of Gifu University, who encouraged the initiation of, and made arrangements for, the start of the research project. The field studies (1973-75) in Gifu were financed by the Department of Environment, Gifu prefecture. Throughout all phases of the work, we received active cooperation from the members of the Crescent Bear Research Group: T. Itoh and K. Maeda of Gifu College of Dentistry, E. Nozaki of Tokyo University of Agriculture and Technology, T. Aoi of Hokkaido University, and others. Field assistance by the students of the Brown Bear Research Group was most helpful. Without their participation, the field studies would not have been possible. M. Asahi of Hyogo Medical College and K. Hayashi of the Japan Monkey Center supplied valuable information and advice and, with K. Eguchi of Kyushu University, kindly allowed citations from their unpublished data. Last, but not least, heartfelt thanks are due the residents of our study areas, who generously shared with us their knowledge of bears and rendered assistance in many ways. This paper is in fact the joint product of all those who contributed to the study.

TRENDS IN HUNTING STATISTICS

The following is an analysis of hunting statistics from 1950 to 1972 taken from Asahi (1977). During the past 22 years, the number of black bears killed has increased from less than 1,000 to over 2,000 animals per year. a linear regression on harvest (H) and year (X), $H = 801.78 + 62.18X$, was obtained and found to be highly significant ($P < 0.01$) (Fig. 1). The rate of in-

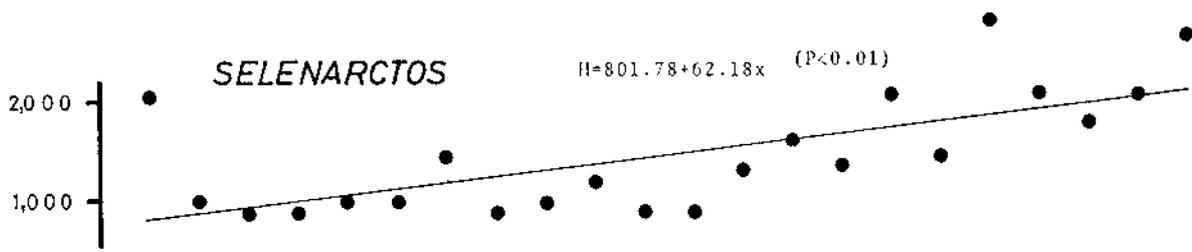


Fig. 1. Trend in the total number of black bears killed annually in Honshu, Shikoku and Kyushu. Data taken from hunting statistics of the Environmental Agency, 1950-72. (Redrawn from Asahi 1978.)

crease is 7.75 percent per year. The number of bears killed by control measures has increased from 410 in 1961-62 to 1,340 in 1970-71 (sliding mean for 2 years) and is the principal source of the rapid increase in the harvest.

The harvest per square kilometer of natural forest (harvest density) exhibits a conspicuous geographical distribution (Fig. 2). Harvest density is low on the islands of Kyushu and Shikoku and in the Chugoku district (western Honshu), moderate in Tohoku district

(northeastern Honshu), and high in several prefectures in the central part of Honshu (Shiga, Fukui, Gifu, Toyama, Nagano, Gumma, and Yamnashi). The range of yearly fluctuation, as indicated by the coefficient of variation (CV) of annual kill, shows an interesting geographical pattern (Fig. 3). CV is high along the periphery of the areas of high harvest density, that is, along the pacific coast and western Japan; although within the areas of high harvest density, CV is generally below 5 and harvests are rather stable.

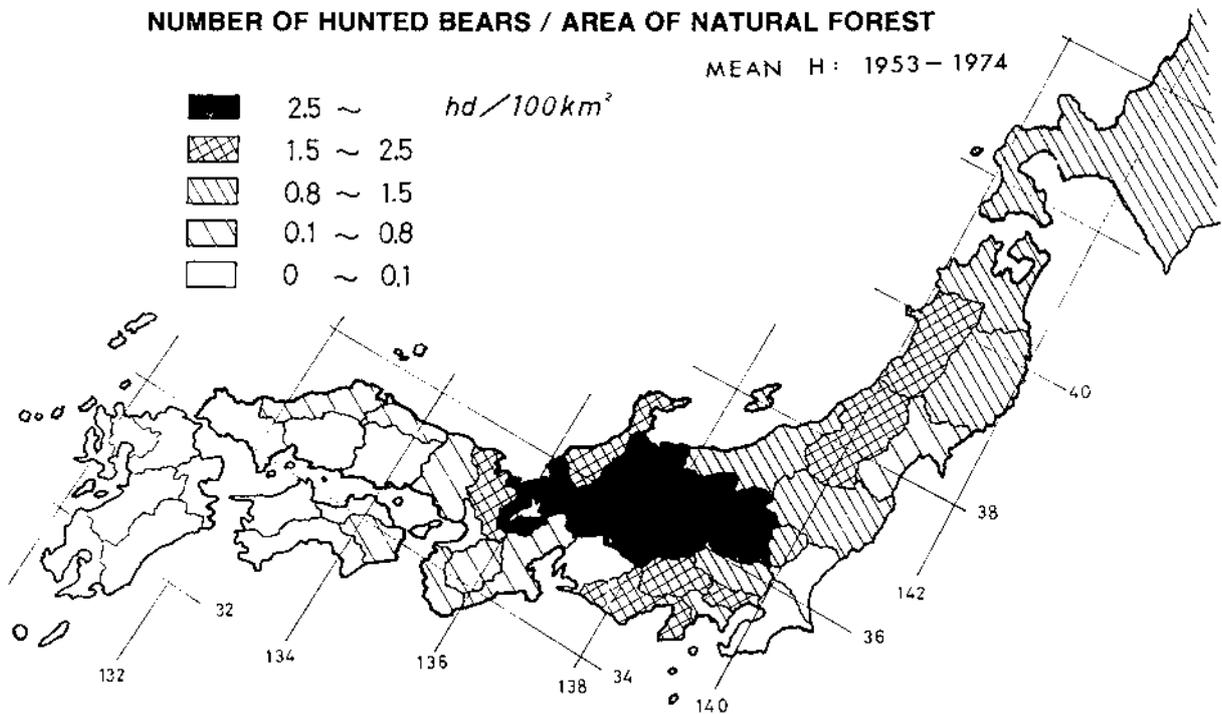


Fig. 2. Harvest density (number of bears killed per area of natural forest) of black bears in Japan. Number of kills is the mean for 1953-1974 (Redrawn from Asahi 1978).

However, stable harvests in these areas do not necessarily indicate the stability of either the populations or habitat quality. The following case histories of 4 regions are presented in order to delineate the current situation in Japan.

REGIONAL CASE HISTORIES

Kyushu Sanchi (Mountain Range, Central Kyushu)

Historical documents from the 8th century record the harvest of bears in secluded mountain villages of Shiiba and Gokanosho for medical use, which indicates that bears once occurred over a wide range along the central mountains of Kyushu. The last remaining stronghold of Kyushu bears is the Sobo-Katamuki Range (1,768 m in elevation), the highest mountain mass of Kyushu Island.

Since 1860, 45 known kills have been recorded, and sites of these kills show that a considerable reduction of range has occurred (Fig. 4). The population was estimated at 20-30 animals in 1960 (Kato 1959). Since then, however, heavy clearcutting has advanced to the 1,600-m level, leaving only a small portion of the original forests of fir (*Abies firma*), beech (*Fagus crenata*), and hemlock (*Tsuga sieboldii*) in the cool-temperate zone. The present range is a narrow high-elevation belt of about 16 km x 2km, in which 4 sight-

ings of bears or bear tracks were reported during the past 30 years (Eguchi 1976).

Chugoku Sanchi (Chugoku Range)

Characteristics of habitat degradation are somewhat different in the Chugoku Sanchi, which extends over 6 prefectures in western Honshu. All along the watershed of the district of Chugoku, sizable expanses of deciduous hardwood forest remain in only 4 small, isolated blocks, each sustaining only a few bears. These are Hyonosen-Funabuse mountains, Mount Ohmangi, Mount Daisen, and Hikimi-Ochi counties of Shimane prefecture (K. Hayashi, personal communication; Yukawa 1975).

The average annual kill for the entire region is 25, but the number of kills for each subpopulation fluctuates irregularly and is not synchronized with the others. For instance, kills in the Hyonosen subpopulation, although numbering 1-3 in normal years, rose to over 20 in 1970 and in 1974. Here, the population of bears was roughly estimated at 20+ in 1974 (Kuwamura et al. 1974), and the remaining suitable habitat is only 10 kmx12 km. In some years, bears wander as far as 20 km from their usual ranges in summer and fall, damage orchards, crops, and coniferous plantations, and are often trapped and killed. We suggest that the reduced area of the habitat and the encroachment of human

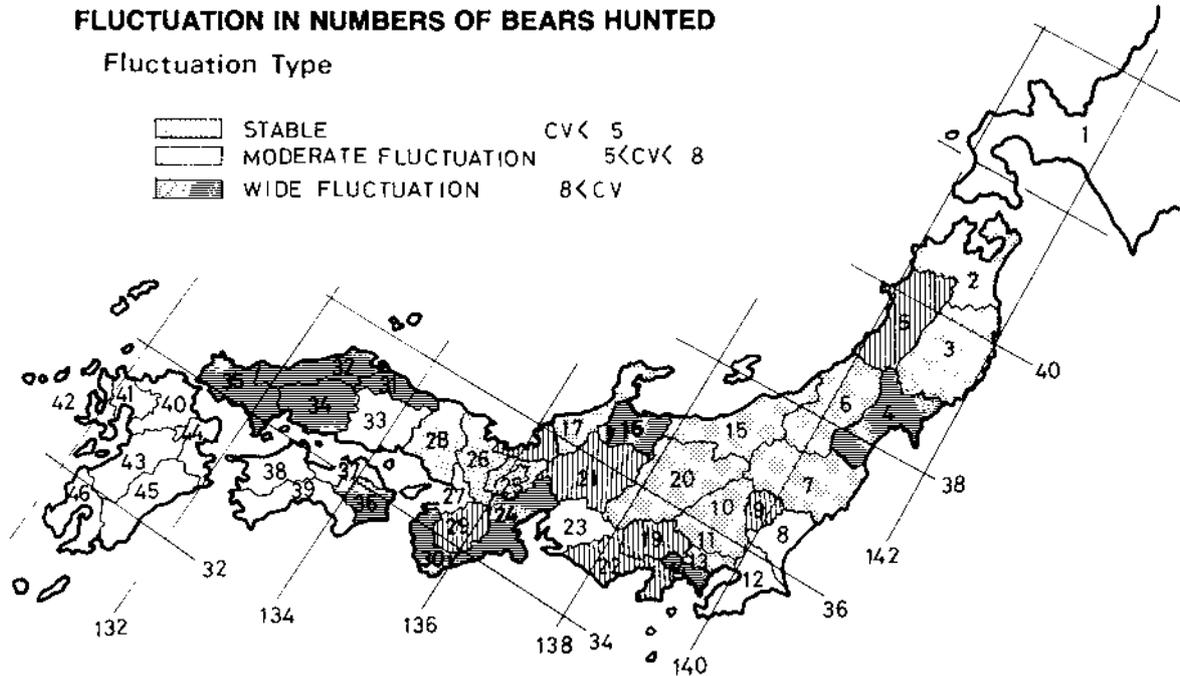


Fig. 3. Relative fluctuations in the harvest of black bears in Japan. Stable: coefficient of variance (CV) less than 5. Moderate fluctuation: CV between 5 and 8. Wide fluctuation: CV greater than 8 (Asahi 1978).

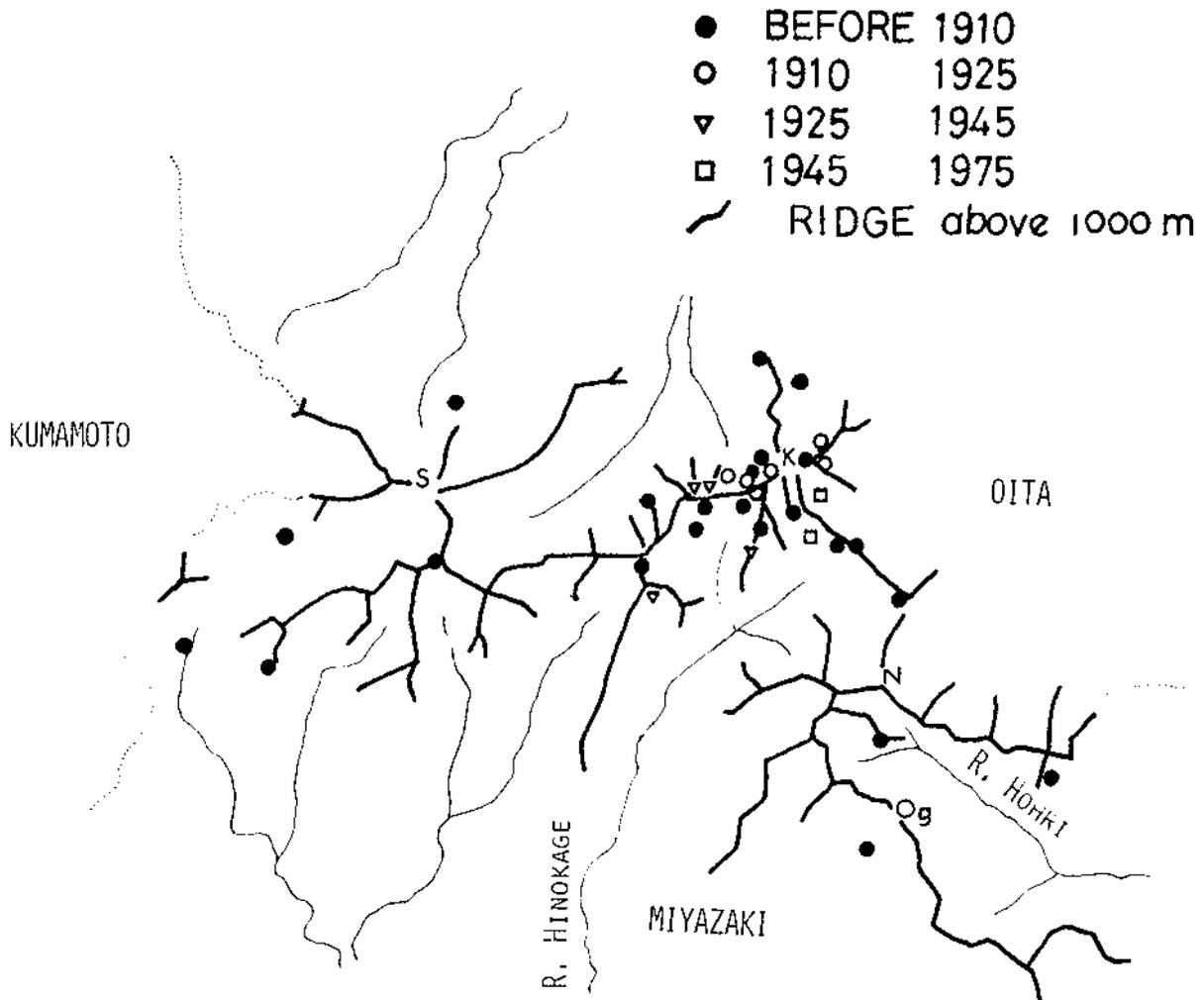


Fig. 4. Sites of black bears kills in Sobo-Katamuki Range, Kyushu, 1860-1975. (Drawn from Kato 1959 and Eguchi 1976.)

disturbances into the area, such as timber-felling and construction of roads and power dams, in addition to poor mast crops, are responsible for the dispersal of bears (Leopold 1933, Schorger 1946). Furthermore, nuisance control in these cases may be effective in eliminating a substantial part of the subpopulation.

Western Part of Gifu Prefecture

Gifu prefecture shows the highest statistics for annual bear kills in Japan, with the numbers ranging between 300 and 400 for the past 5 years. The upper basin of the Neo and Ibi rivers in the western part of Gifu prefecture has been our study area since 1972 (Azuma et al. 1976).

The area is mountainous, with elevations from 400 m to 1,600 m. Four hundred square kilometers of steep terrain are dominated by a hardwood forest of beech on

the upper slopes and a *Quercus serrata-Castanea crenata* secondary forest on the lower slopes. Both of these forest types are interspersed with stands of Japanese cypress (*Chamaecyparis obtusa*) and fir, which usually occurs on steep, rocky ridges. Artificial plantations of cryptomeria (*Cryptomeria japonica*) and Japanese cypress are largely restricted to lower elevations, along valleys and near villages. Percentages of afforestation are low (13-29 percent).

A map of bear range in this region was drawn from interviews with hunters, forestry workers, and local residents (Fig. 5). The area where bear sign was found during spring and summer in most years may be considered the normal range. Den-hunting occurs in this part of the country and pursuit hunting takes place in fall and spring. The known sites of the dens where bears were taken fall within or on the margin of their normal

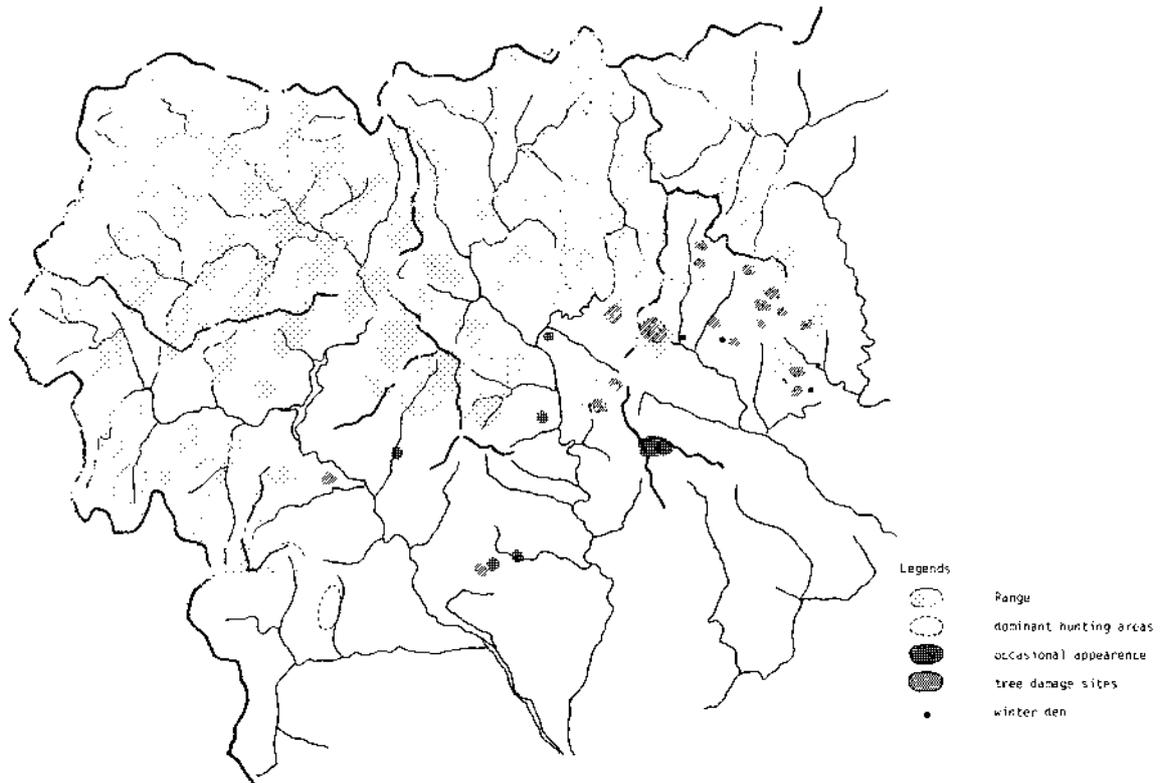


Fig. 5. Distribution of black bear range, known winter dens, hunting areas, and sites of tree damage by bears, western Gifu prefecture.

range. Bears are known to have appeared in some locations outside their usual habitat in a few of the past 10 years.

Distribution and trends of bear damage. — Bear damage to trees is localized and occurs only in the blocks of forest land in the eastern part of the region. In the western part of Neo Dani Valley, where hardwood forests cover over 75 percent of the terrain, mature conifer plantations are rarely damaged by bears. We found only 8 instances of damage in 450 ha, sporadically and thinly distributed. Some bear damage is found occasionally in the marginal areas of normal range; it occurs for 1 or 2 years and then subsides for several years.

The area of heaviest bear damage in the eastern blocks overlaps the area of nearly continuous mature man-made forest, where forest cover exceeds 70 percent. Although the history of planting conifers dates back to the 1880s, bear damage was not a problem until 1960.

Population density. — Estimates of the size and composition of the bear population occurring on a 2,700-ha survey plot at the headwaters of the Neo Nishitani River were obtained from 1973 to 1975. Estimates were made by distinguishing sighted individual bears through physical characteristics, size, and accompanying young. Size and location of tracks of non-sighted bears were used as supplementary information.

The figures remained fairly stable for the 3 years. Apparent density for the area was 0.19-0.29 bear per km^2 (Table 1).

In the spring of 1976, extensive tree damage was found in the neighboring valley of the Neo Higashitani River, where control operations were undertaken. Five traps were set over an area of 2,200 ha from June through August. Elimination of bears from the sector was confirmed by 15 August (Table 2). The apparent density was 0.32 bear per km^2 before the control operation. This example shows the efficacy of the trap-and-kill method of control that is commonly followed in Japan.

Table 1. Estimates of the size and composition of the bear population in the 2,700-ha survey plot at the headwaters of the Neo Nishitani River, Gifu prefecture.

Season and year	Bears sighted	Number of Units
Spring (April-May) 1973	Adult, large	2
	Adult female and cub (0 yr)	1
	Adult female and yearling (1 yr)	1
	Immature (2-3 yr)	1
	Unknown	1
	Total	8
Spring (April-May) 1974	Adult, unknown sex	1
	Adult, female and cub (0 yr)	1
	Adult female and yearling (1 yr)	1
	Unknown	2
	Total	7
Fall 1975	Adult, unknown sex	1
	Adult female and yearling (1 yr)	1
	Young adult male	1
	Immature male (2 yr)	1
	Unknown	1
	Total	6

Table 2. Estimates of the size and composition of the bear population in a 2,200-ha area of tree damage in the valley of the Neo Higashitani River, Gifu prefecture. Determined by complete elimination of bears through control procedures, June-August 1976.

Bears eliminated (N = 7)				
Age	Sex	Weight (kg)	Date of capture	Trap site
Immature	M	18.0	2 Aug 76	4
Immature	Unknown	20.6	16 June 76	1
Adult (old)	F	42.2	28 June 76	1
Adult	F	43.1	22 June 76	2
Adult	M	50.6	18 July 76	3
Adult	Unknown	Unknown	30 July 76(?)	5
Unknown	Unknown	Unknown	2 Aug 76(?)	Unknown

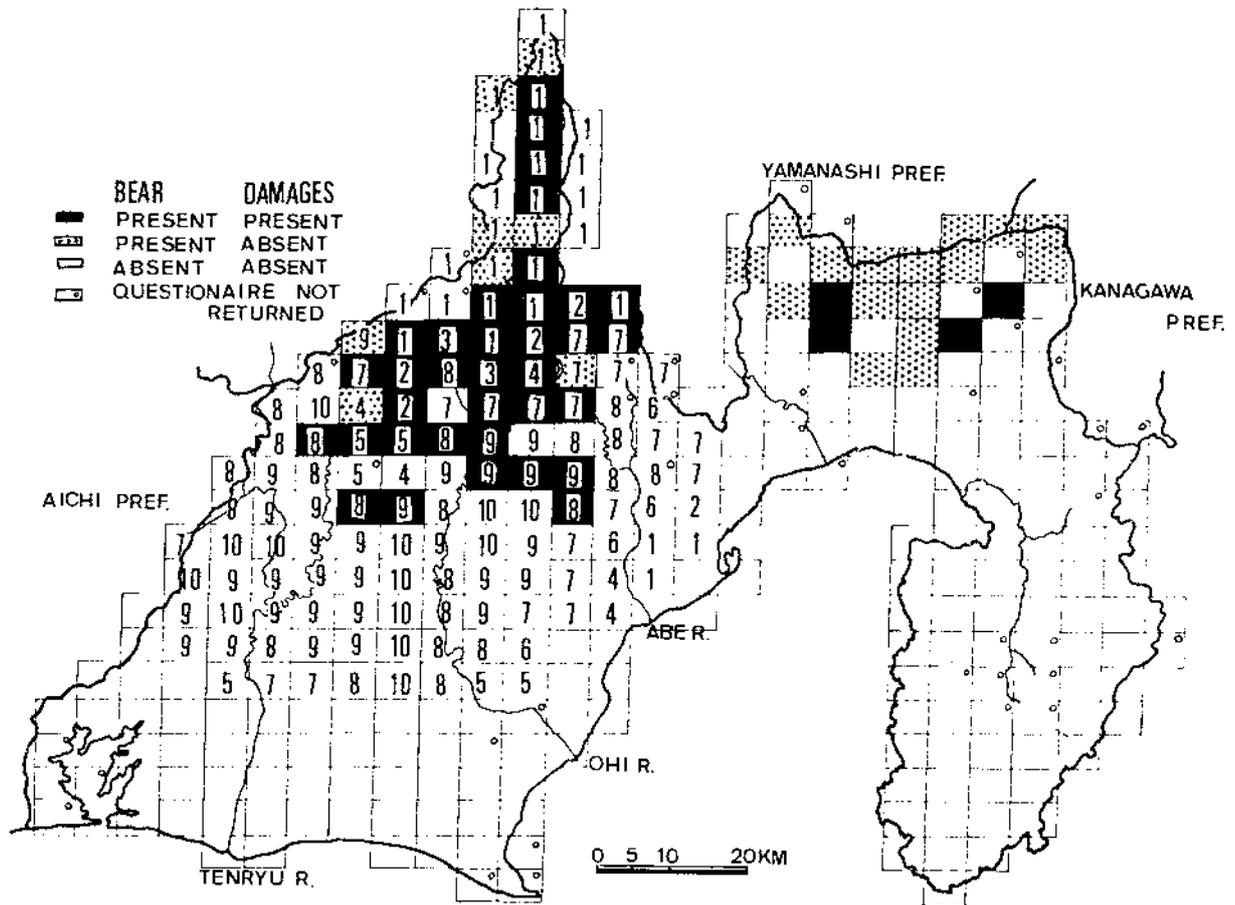


Fig. 6. Distribution of bear damage and percentages of forest cover in Shizuoka prefecture. Figures in the blocks denote percentage of forest cover taken from vegetation map prepared by F. Konda. Data on distribution are based on questionnaires.

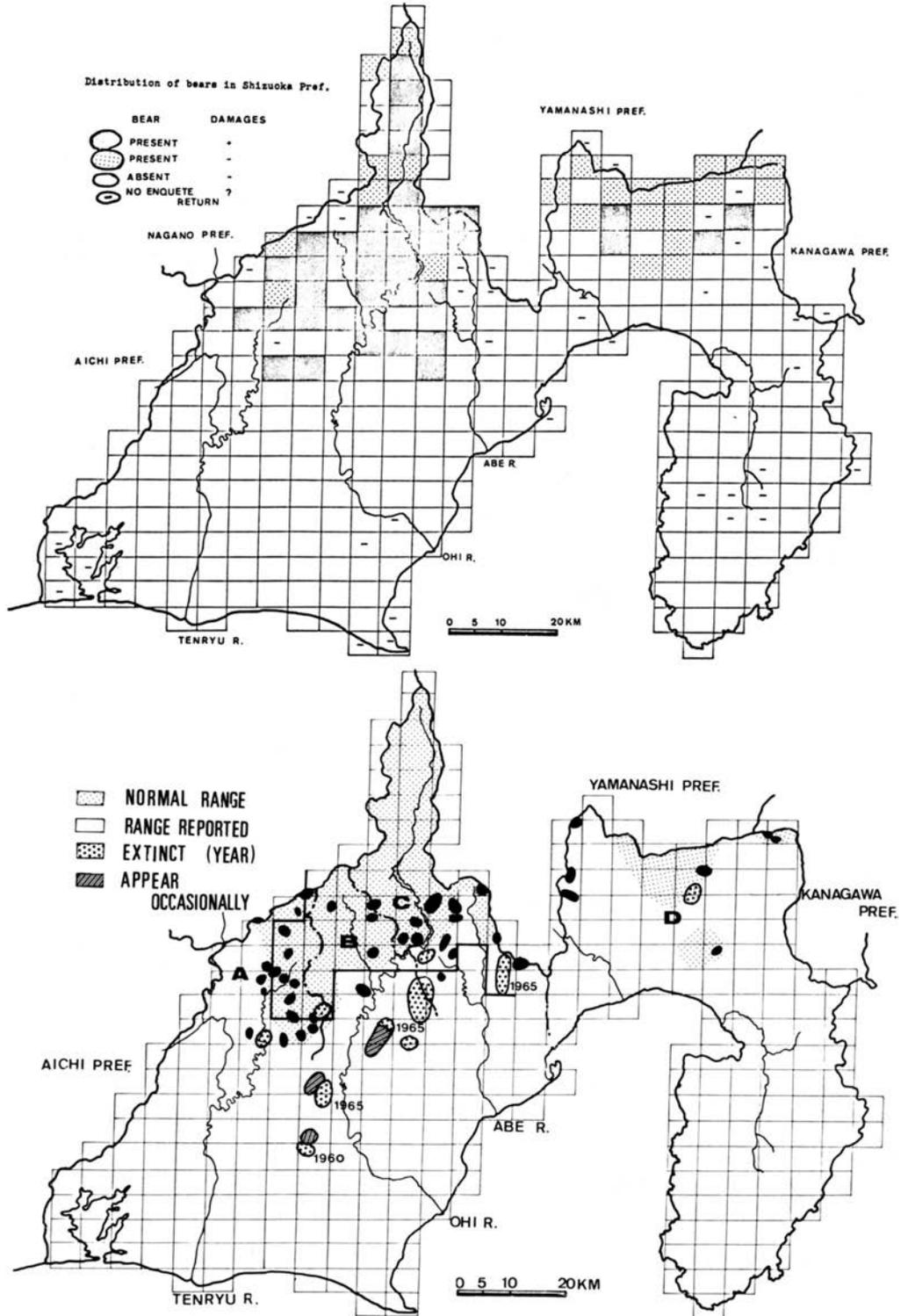


Fig. 7. A. Bear range in Shizuoka prefecture. Normal range has decreased during 1960-76. B. *Normal range* is based on survey data. *Reported Range* is based on hunters' reports of areas where bears survive. *Appear occasionally* also includes declining small populations (see text). Heavily lines along the grid (A, B) outlines areas where forest cover is less than 70 percent.

Western Part of Shizuoka Prefecture

Torii has been gathering hunting data here since 1968 (Torii 1977). The middle and upper reaches of the Tenryu, Ohi, and Abe rivers embrace a largely forested area of about 2,500 km². Elevations vary from 200 m to 3,000 m.

The lower portion of the black bear range is covered by *Quercus-Castanea* coppice-regeneration forests. On higher slopes in the cool-temperate zone, oak (*Q. mongolica*) — maple (*Acer mono*) forests and *Abies-Tsuga* coniferous forests occur. Above 1,800 m, subalpine conifers cover steep slopes and ridges. Along the middle streams, *Cryptomeria* and *Chamaecyparis* forest cover is widespread and is advancing upstream (Fig. 6).

The range map of black bears in Shizuoka (Fig. 7A, B) was based on information obtained from questionnaire returns from game guards, forest-owners' associations, and hunters. Areas of reported local extinction often occur close to areas of "occasional appearance." We could not discern whether a particular area represented a recent decrease in the size of a detached segment of a breeding population that was locally near extinction or was simply a place where stray bears were seen infrequently. These questionable sites were located at a distance of about 10 km from the normal range. The normal range of bears is, however, broadly determined by the amount of forest cover. The range is outlined by the blocks where forest covers over 70 percent of the area, which shows that the survival of bears is negatively influenced by extensive man-made forest cover.

Bear damage is seen along the periphery of natural forest areas, where susceptible forest stands (Poelker and Hartwell 1973) are increasing at the same time.

Harvest trends show a drastic decrease in numbers of bears killed in Misakubo and Senzu (Fig. 8). The population of bears resident in these areas is believed to have been almost eradicated. This conclusion is also supported by the lack of bear damage in these areas.

SUMMARY OF THE ECOLOGICAL CONSEQUENCES OF HUMAN INTRUSION INTO BLACK BEAR RANGE

Through examination of these 4 regional cases of bear-habitat-human interaction, the following dynamics are indicated:

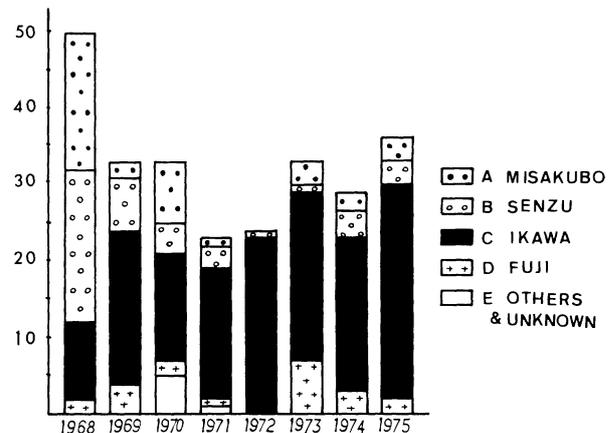


Fig. 8. The number of bears killed each year in different regions of Shizuoka prefecture. A-D refer to locations on Fig. 7B. Harvests in Misakubo and Senzu have rapidly decreased as bears become locally extinct. (Bears caught in the last few years had probably entered these areas from other regions only recently.)

1. A rapid increase in the percentage of forest cover in a regime usually not only reduces the favorable habitat of bears but also induces increased outbreaks of tree damage by bears in mature regenerated stands in neighboring areas.

2. In areas where tree damage by bears is severe, mature stands generally sustain the most extensive damage.

3. As the only means of forest protection, trap-and-kill practices using cage traps with beehive baits are encouraged by the government. These measures are so effective that the natural population of bears over a wide area is eliminated within a few years.

4. Reduction of natural forest, large-scale lumbering, and road and dam construction in an area tend to increase the possibility and the extent of bear intrusion into adjacent agricultural and forest lands. Combined with the vermin-control practices, this displacement increases the vulnerability of the remaining subpopulations of bears.

5. Where sufficient natural habitat is left intact, tree damage is sporadic, inconspicuous, and limited to conifers of natural forests, and the influx of bears into other areas is restricted to comparatively short distances, even in years of poor *Fagus* and *Quercus* crops.

6. Some areas continue to show stable harvest statistics when bear range is reduced, even when the subpopulation has been eliminated.

LITERATURE CITED

- ASAHI, M. 1978. On the trends in the harvest of wild boars, deer and bears in Japan. *J. Mammal. Soc. Japan* 7(4):206-218 (In Japanese with English summary.)
- AZUMA, S., T. ITOH, K. MAEDA, E. NOZAKI, T. AOI, AND H. TORII. 1976. Ecology of Himalayan black bear in Neo Nishitani Valley. Pages 3-52 in *Crescent Bear Research Group, ed. Bear in Gifu prefecture*. (In Japanese with English summary.)
- EGUCHI, K. 1976. A brief report on serow survey. *Vulpes* 3(3-4):1-7. (In Japanese.)
- KATO, S. 1959. Sobo-Oogue Sangun ni okeru Kuma no Kakocho to Kamoshika (Bear necrology and serows in the Sobo-Oogue Range). Pages 94-108 in S. Kato and T. Tateishi, eds. *The Sobo-Oogue Sangun*. Shin-tsukushi Mountaineering Soc., Fukuoka.
- KAWAMURA, S., T. IZUMI, AND K. SHIZUKUISHI. 1974. Mammals in the Higashi Chugoku Sanchi. Pages 67-80 in *Higashi Chugoku Sanchi Shizen Kankyo Chosa Hokoku* (Survey of natural environment in eastern Chugoku Range), Hyogo, Okayama and Tottori prefectures. (In Japanese.)
- LEOPOLD, A. 1933. *Game management*. Charles Scribners' Sons, New York. 481pp.
- POELKER, R. J., AND H. D. HARTWELL. 1973. Black bear of Washington. Washington State Game Dept. *Biol. Bull.* 14. 180pp.
- SCHORGER, A. S. 1946. Influx of bears into St. Louis County, Minnesota. *J. Mammal.* 27(2):177.
- TAKAHASHI, K. 1974. *Tsukinowa-guma monogatari* (A story of Japanese crescent bear). Chikuma-Shobo, Tokyo. 198pp.
- TORII, H. 1977. Ohoi Gawa Genryu no Tsukinowa-guma. *Hito to Shizen* 2(1):42-50. Ryoku-in Shobo, Tokyo.
- WATANABE, H. 1974. *Tsukinowa-guma no hanashi* (About Japanese crescent bear). NHK Books, Tokyo. 172pp.
- , AND A. KOMIYAMA. 1976. Conservation of the black bear and forest protection (II). *Kyoto Univ. For Bull.* 48:1-8. (In Japanese.)
- YUKAWA, H. 1975. Cases of bears hunted. *J. Mammal. Soc. Japan* 6(4):173. (In Japanese.)