Black Bear Population at the Mountain Road Construction Area in Chichibu, Central Japan

Ken Ishida*1, *2

Introduction

Construction was carried out on a portion of the national road Route 140 in the Chichibu mountains, Saitama, central Japan throughout the 1980s and 1990s. The section of interest passes through a steep mountainous area covered with well-reserved natural temperate forest within University Forest in Chichibu, the University of Tokyo (Ishida et al., 1991; Ishida et al., 1994; UFUT, 1998). Because of the high levels of biodiversity in the area, the impact of that road construction and traffic has had on the forest ecosystem, and animal populations has been a topic of interest.

The University Forests, the University of Tokyo (UT) received trusts to conduct the nature surveys in relation to the construction of Route 140 in 1986–1997 from Ministry of Construction and later in relation to the traffic from Saitama Prefecture government. The author conducted a 10-year ecological survey as a part of this research project in between 1990–1999. The intimate objective of this study was to estimate the presence of habitat fragmentation due to Route 140, with respect to large mammal populations (Ishida et al., 1991), by interpreting the actual data on black bear population in this area (Ishida et al., 1994).

The black Bear (Ursus thibetanus japonicus) is a largest and common mammal in the broad-leaf deciduous forests in central to northern Honshu Island, Japan, and small populations have been extinct or threatened in western Japan (Hazumi, 1996; Ishida, 1995). The species is sometimes thought of as a symbol of forest biodiversity.

The Black bear is a “phytophageous carnivore” adapted to seasonally and unpredictably changing resources, and its breeding is believed to be strongly dependent on the masting mainly of beech family trees in central Japan (Ishida, 1995). The mortality of adult bears is supposed to be an important factor in population extinction by the demographic simulation by Mimura and Horino (1999). Each individual of an animal not always behaves for the fittest for the population survival or reproduction, and population fragmentation can have a significant affect on the population (Matsuda and Abrams, 1994; Ishida, 1995). The road has two short and one six-kilometer long tunnels in this area, that are expected to function as a kind of corridor for bears, which may decrease problems of population fragmentation by Route 140. To learn about bear population condition and the affect by Route 140, we need to estimate their density, home range sizes and location, and demographic parameters.

Although the presence of bears in their main habitat of natural broad-leaf deciduous forests with nut and acorn trees can be confirmed by the field sign such as fecal droppings, claw marks on tree trunks and feeding platforms in the tree crowns, direct observation of the bear in nature is almost impossible, as they usually quickly and quietly escape human beings in the natural habitat. Thus the capturing of bears is necessary to effectively survey

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ecology and population parameters. In this study we obtained some density and home
range estimates, capturing bears and marking them with ear tags, microchips and radio-
transmitters.

Study Area

The study area is located in the western part of Ohtaki Village, westernmost Saitama,
called Okti-Chichibu, central Japan. It is near the border of four neighboring prefectures,
Tokyo, Yamanashi, Nagano and Gumma (Fig. 1). There are two large valleys in the main
research area, Takikawa and Irikawa Valleys. The national Road route 140 has constructed
on the northern slope of the Takikawa Valley and there is a small and unpaved mountain
road of the University Forest in Irikawa Valley. The structure of the national road is
supposed to be a barrier of many mammals to cross and its traffic might be more, but the
university forest's road is small enough or traffic is well restricted not to disturb them
(Ishida, et al., 1991). The Paleozoic and Mesozoic bedrock is hard and has been scraped
away by erosions over a hundred million of years. As a result, the slope within the area is
steep especially close to the bottom of main valleys of Takikawa and Irikawa, and at the
entrance of their branch valleys (Ishida et al., 1993).

A significant amount of primitive and secondary old broad-leaf natural forest remains
in the study area, which covers more than 80% of the university forest (Ishida et al., 1993).
The elevation of the study area is from about 600 m to 2,000 m. Black bears spend most of
their time in the cool temperate deciduous forest and mixed forest below 1,500 m (Ishida,
personal observation on field sign).

About 160 species of trees have been recorded in the University Forest in Chichibu, UT.
The vegetation diversity is high as a result of a large range in elevation and complex
terrain with rich rain fall (University Forests, 2001). Most of the area is covered by second
growth deciduous forest of oaks (mainly Quercus crispula), beech (Fagus crenata), japanese
beech (F. japonica), chestnut (Castanea crenata), maples (Acer spp.), cherry trees
(Purnus spp.) and a mix of other species. The proportions of species vary from place to place.
The dominant tree species are beech and japanese beech on the slopes, hemlock (Tsuga sieboldii)
and fir (Abies firma) on the ridges, and senwood (Fraxinus spaethiana) in the rocky valleys.
Other species present that provide food for bears include vines of wild grape (Ampelopsis

Fig. 1. 13 Locations of the study area and the bear traps (15 traps at 13 sites).
brevipedunculata), arguta (Actinidia arguta), and bushes of raspberries (Rubus spp.), etc. Nuts and acorns of beeches, oaks and chestnut trees are important food for the bear (Hashimoto, 1995). Although nuts and acorns are characteristic for their large and irregular annual fluctuation of crops or masting (Kelly, 1994; Miquel, 1996), in this area the four main species’ (F. crenata, F. japonica, Q. crispula and C. crenata) masting are not always synchronized, thus allowing for less fluctuation in the food resources for bears compared with other areas on Honshu Island.

Method

We set 15 bear traps at 13 sites (Fig. 1, Table 1). Traps were made of two or three oil barrels attached to each other and a beehive with bees and honey was set inside as the bait. The trap was configured so that the bear triggered the larch on the front door, allowing it to close, when it attacked on the bait (Ishida, et al., in preparation). Seven traps at seven sites were set in the Takikawa Valley around route 140, and the others in the Irikawa Valley. With this trap allocation we supposed to catch bears from two areas, the national road and the wild, for comparison. We initially attempted to capture bears from mid April to mid December between 1990 to 1992, and later only during July, August and early September, from 1993 to 1999. The trapping period was shortened to those seasons in the latter seven years, because almost all bears were caught during the summer in the former years.

Numbered ear tags were attached all the trapped bears. Microchips (Trovan Limited, Germany) were also implanted inside the skin beyond the right ear of the bears captured from 1995 to 1999. We also fitted collar mounted VHF radio-transmitters (ATS and Telonics Corporation, USA) on larger individuals.

We roughly located bears fitted with radio-transmitters determining the direction and strength of the wave with Yagi and/or rod-antenases, and noting the presence or absence of ridges as barriers or reflectors of the radio wave. This combination of information was used to home in on the location to a small valley or a ridge, around which a circle of a hundred meters in diameter was recorded. Annual home ranges were estimated by drawing an outline of all location points and/or circles.

Results

Capture of Bears

Twenty-two females and 36 males were caught 136 times, during nine trapping seasons. No bear were caught in 1990. We captured three bears in 1991, nine in 1998 and five in 1999. From five to seven females and six to ten males were captured 18 to 24 times, each year, between 1992 and 1997. After 1993 recaptured bears were caught every year and in

<table>
<thead>
<tr>
<th>Area</th>
<th>Trap #</th>
<th>Site name</th>
<th>Terrain</th>
<th>Altitude (m)</th>
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<td>Kudonosawa</td>
<td>Slope</td>
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<td></td>
</tr>
<tr>
<td>02</td>
<td>Migurosawa</td>
<td>Ridge</td>
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<td></td>
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<tr>
<td>03</td>
<td>Takadaira</td>
<td>Slope</td>
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<td></td>
</tr>
<tr>
<td>04</td>
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<td>Ridge</td>
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<td></td>
</tr>
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<td>Ridge</td>
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</tr>
<tr>
<td>16</td>
<td>Akagisawa</td>
<td>Ridge</td>
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* The national road Route 140 was constructed in the Takikawa area.
Table 2. Number of bears of captured and re-captured each year in the two areas

<table>
<thead>
<tr>
<th>Year</th>
<th>Takikawa*¹</th>
<th>Irikawa</th>
<th>Total*²</th>
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</tr>
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Table 3. Number of bears of each sex caught in each area

<table>
<thead>
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<th>Year</th>
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<tbody>
<tr>
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<td>5</td>
</tr>
<tr>
<td>1999</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Abbreviations, nwcp = newly captured; recp = re-captured; (in annual record, in each area)
*¹ The national road Route 140 was constructed in the Takikawa area.
*² Individual numbers of each year. As there were bears caught in both area at one year, the total number is not the same as the sum of the left four columns.

and 16 males (<40 kg) in total. The sex ratio of trapped adult bears was almost equal every year. The exception was that of the Takikawa area in 1993, when no male was caught (Table 3). This result suggests that the density of the male bears is the same as that of females.

The numbers of bears captured in the Takikawa and the Irikawa areas did not differ significantly between sexes or among years, with the exception of no males captured in 1993 in the Takikawa area. The number of females captured in the Irikawa area was smaller than that of males in 1995. However that seemed to be partly caused by the repeated capture of two small juvenile males, nine times, and the resulting decrease in trap availability in the Irikawa area for that year.

Home ranges and density

We fitted 23 individuals 34 transmitters. The movement of 16 individuals was traced continuously from two to six years. Dispersal of two males was confirmed by hunting reports from remote areas in 1995 and 2000.

The outlines of the home ranges of six, eight and seven female bears in 1994, 1995 and 1996 are shown respectively in Figs. 2–1 to 2–3. All of these female ranges are overlapped or touched each other. Thus I supposed that all the breeding female bears were monitored with radio transmitters during those three years. Dividing the total area of these ranges by the number of them, we estimated the average female density to be about one bear per 7 to 8 square kilometers. Range sizes were similar between the Takikawa and the Irikawa areas. The main valleys of Takikawa and Irikawa functioned as borders for female home ranges, probably because of the very steep slopes along the bottoms.

The home range outline of male W1 encompassed an area of 60 square kilometers in 1991–1992, and 14 square kilometers in 1993. Accurate estimates on the home range sizes
and locations of the other males or for the same male in the other years were not available because they often crossed the main valleys and ridges of the study area, moving to areas inaccessible to radio-tracking.

Male S26 was caught at Iriyama site and fitted with a radio-collar (Table 1 and Fig. 1) on July 14, 1992, and recaptured at Takadaira site, about three kilometers away on July 24. It was tracked around the Takikawa area until September 18 of the same year before contact was lost. We learned later that S26 was shot at Ichinose, Yamanashi, about nine kilometers far from the second capture site at Takadaira, on October 12 (Fig. 3). Although 1992 was a poor crop year for all nuts, acorns and other fruits in the Oku-Chichibu area, there were many oak trees with partly fruited acorns at Ichinose (Ishida, personal observation), likely contributing to the far-ranging movements of S26.

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**Fig. 2-1.** Female home range outlines, 1994.

**Fig. 2-2.** Female home range outlines, 1995. Arrows indicate the movement for denning.
Fig. 2-3. Female home range outlines, 1996.

Fig. 3. Male W1 home range outline and the large distance movement records of males S26 and S42. Location of the national road Route 140 is also shown.
HANAMOTO, U.T. contributed a large portion of the haul work. T. HAZUMI, WILDlife.

Acknowledgement

such large-scale corridors is important to conserve large mammal populations.

Population size and increase in the exclusion of the bear population size is a result of the population size, which can exist by mathematical model simulation. Where population and human scenarios are considered, the possibility of small areas being unoccupied by bears is greater. The decrease of bear population size is a result of the bear population structure. However, active measures should be considered to play more positive roles in reproduction.

Bears tend to more Remote, possibly, constructing, monitoring food resources and female population structure of a bear population. A larger distance of a bear is important, as bears are highly mobile. The decrease of bear population size is a result of the bear population structure. Where population and human scenarios are considered, the possibility of small areas being unoccupied by bears is greater. The decrease of bear population size is a result of the bear population structure. However, active measures should be considered to play more positive roles in reproduction.

Discussion

The results of this study are

Black bears mostly inhabit broad-leaved forests. However, we do not have data on the black bears' movement behavior, so we cannot determine their distribution in our study area.

There was a mountain range of about 2000 m in altitude between the capture area and the

Another study was reported to have been carried out in agreement of Japanese marine biology.
Management Office Ltd. (WMO), kindly provided a wide variety of knowledge and techniques to conduct bear research at the beginning of the study, as well as valued advise throughout the course of the research. K. Kishimoto and A. Yasutake, WMO, also advised on the sampling methods of captured individuals.

R. Yamanaka, T. Akaiwa of University Forest in Chichibu, and Y. Kamizuka of Ohtaki Village provided useful information on capturing techniques and old records of bears. S. Shibano of University Forest in Hokkaido, supported me for two years in the field and taught me many useful bear handling techniques.

C. Angeli kindly corrected my English manuscript.


H. Machida, G. Yamamoto, H. Suzuki and A. Kameyama also assisted with in the field work. I sincerely thank them all for their support of this research.

Summary

To estimate the effect of national road Route 140 construction on the black bear population, bears were caught with barrel traps with a bait of beehive in the two neighboring areas of Takikawa and Irikawa Valleys in Chichibu, Central Japan.

The body sizes were measured and the body conditions recorded. A part of larger adult bears were fitted a collar transmitter and their home ranges were traced roughly. 58 individuals were caught in 136 times and 34 transmitters were fitted on 23 individuals during the 1991–1999 seasons.

Average density of breeding female was estimated as one bear per 7 to 8 square kilometers for six to eight individuals within the research area in 1993, 1994 and 1995. In Takikawa (Route 140) area no adult male was caught in 1993 and only a few immature males in 1994. One adult male was killed by a hunter about nine kilometers far from the research site within ten days since it left the area in October 1992, when the crops of the trees were all poor.

It is supposed that the Route 140 construction partly and temporally delayed the recovery of mature males in the area and the tunnels along the Route 140 act as corridors.

Key words: automobile road, habitat fragmentation, Japanese black bear, hunting, food resource

References

Hashimoto, Y. (1995) Food habit of Japanese Black Bear (Ursus thibetanus japonicus) in Chichibu. Thesis of Masters Degree, Graduate School of Agricultural and Life Sciences, University of Tokyo. 35 pp + XIV.**


Ishida, K. and Hashimoto, Y. (In preparation) Japanese black bear body conditions and masting of beech family trees.


(* in Japanese, ** in Japanese with English summary)

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東京大学秩父演習林の国道 140 号線施設地域における
ツキノワグマ個体群の生息状況

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要  旨

東京大学秩父演習林の中に開通した国道 140 号線の施設が、演習林とその周辺のツキノワグマ
個体群に与える影響を評価するために、隣り合う滝川流域と入川流域において、ミツバチを誘引
餌としたドラムカン製捕獲器でクマを捕獲した。

捕獲個体の体重や体調を記録した。大型個体には首輪式の発信機を装着して、行動圈を調べた。
1991 年から 1999 年の主に夏季にツキノワグマの 58 個体を 136 回捕獲し、23 個体の成獣に 34
個の電波発信機を首輪で装着して行動圈を調べた。1993 年から 1995 年における行動圈の調査
結果から、調査地で繁殖していたと推定される 6 〜 8 頭の雌の成獣は 7 〜 8 平方キロに 1 頭てい
どの密度で生息していると推定された。調査地内で雌の繁殖がすべて雌アの 1992 年に、発信機
を装着した雌の 1 頭が直線で約 9 キロ離れた塩山市一ノ瀬で射殺されたことが確認され、1993
年には国道周辺の滝川流域で雄の成獣が 1 頭も捕獲されず、1994 年には同地域で未成熟の雄が
捕獲されただけだった。

国道 140 号線が施設されていたために滝川流域での雄の成獣の生息個体数の回復が遅れた可
能性があると考えられた。演習林内にあるトンネルが生息地の分断効果を和らげる重要な機能を
持つことを示唆した。

キーワード：自動車道路・生息地分断・ツキノワグマ・狩猟・食物資源