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Differences in Density and Body Condition of Small Rodent Populations on Different Distance from Road

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Abstract : This study was conducted to identify the road effect on small rodent populations within fragmented forest areas around the road from June to September 2002, in 9 study sites of Baekdugdaegan mountains, Korea. Two species of small rodents, Korean field mouse *Apodemus peninsulae* and striped field mouse *Apodemus agrarius,* were captured in this study. Korean field mouse preferred forest area, and striped field mouse generally has been found edge area around road. Mean body weight of Korean field mouse was significantly different, but that of striped field mouse was not between both distance from road. Korean field mouse is forest-dwelling species and their distribution is limited in forest area. In contrast, striped field mouse has wide distributional range around road. The effects of road is different in each small rodent species and their habitat preferences.

Key words **:** *baekdudaegan, fragmented forest area, road, small rodents*

Introduction

Habitat destruction is the primary cause for the extinction of most terrestrial species, but the impacts of any human development or road may be far greater than the immediate area of the destruction (Bailie and Groombridge, 1996). Mammals are major agents of habitat changes in many parts of the world (Anderson and Katz, 1993). Species interactions and responses to habitat fragmentation may vary for species within patches that adjoin different patch types (Paton, 1994).

The construction and maintenance of roads were most widespread forms of modification of the natural landscape during the past century (Noss and Cooperrider, 1994). Roads contribute to biodiversity loss, both directly via animal mortality related to traffic, and indirectly through the destruction and fragmentation of habitats. Their ecological effects are not limited to the road region itself but can spread to a much large area (Meuiner *et al.*, 1999).

Direct habitat loss and factors related to roads and traffic that may affect habitat quality or animal movements can reduce survival probability or population density too (Huijser, 2000). Isolation, traffic noise, visual stimuli (e.g. lights), pollution (e.g. salt, heavy metals, nitrogen-containing compounds, herbicides), management activities in the road-side verges, increased human access, erosion and sedimentation are generally considered to have the greatest effects on habitat quality (Forman and Alexander, 1998; Huijser *et al.*, 1999; Forman and Deblinger, 2000; Huijser and Piet, 2000).

By the road construction, the habitat of small rodents would be lost, directly. Forest edge would be created around the road. Population dynamics of small rodents around road would be influenced by edge effects (Ministry of Environment, 2003). Density and body condition would be useful parameters for population status of small rodents (Huijser and Piet, 2000).

This study was conducted to identify the influence of road on density and body condition of small rodent populations in different distance from road within Baekdudaegan mountains, Korea. We hypothesized the existence of road would affect to the distribution and body condition of small rodent populations.

Methods

This study was carried out in 9 fragmented forest areas, Hangyeryeong (N 38° 08' 21", E 128° 24' 33", 720

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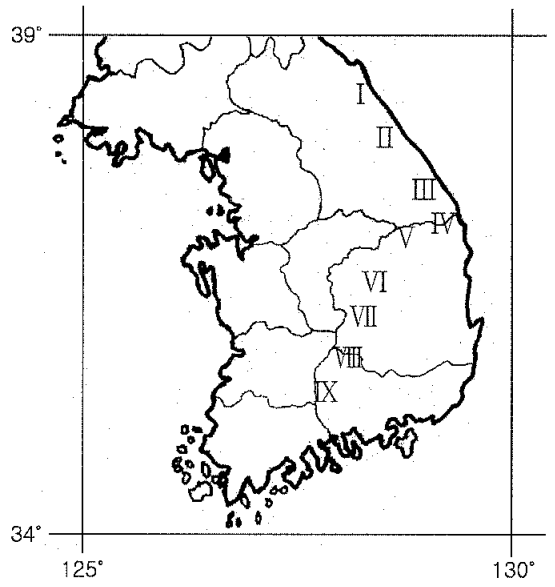

Figure 1. The location of study sites in Baekdudaegan mountains, Korea. (I: Hangyeryeong, II: Dakmogryeong, II: Daetjae, IV: Doraegijae, V: Beoljae, VI: Bamtijae, VII: Jilmaejae, VIII: Sinpungryeong, IX: Bokseongijae)

m a.s.l.), Dakmogryeong (N 37° 37' 16", E 128° 46' 32", 700 m a.s.l.), Daetjae (N 37° 23' 36", E 129° 00' 08", 610 m a.s.l.), Doraegijae (N 37° 02' 12", E 128° 47' 49", 740 m a.s.l.), Beoljae (N 36° 47' 58", E 128° 19' 17", 640 m a.s.l.), Bamtijae (N 36° 34' 59", E 127° 53' 05", 500 m a.s.l.), Jilmaejae (N 36° 03' 53", E 127° 57' 30", 720 m a.s.l.), Sinpungryeong (N 35° 51' 57", E 127° 49' 44", 690 m a.s.l.) and Bokseongijae (N 35° 30' 46", E 127° 33' 20", 600 m a.s.l.) within the Baekdudaegan mountains, Korea (Figure 1). Three trapping plots were established in each 9 fragmented forest areas from June to August, 2002. The study areas, Baekdudaegan mountain range involves high elevation mountains, diverse topographies and abundant species diversities in flora and fauna (Shin, 2002). For these reasons, three plots were chosen as similar forest structure to minimize differentiation of environmental factors such as, elevation, forest type, vegetation coverage and topography, except for a road effect in each 9 fragmented forest areas.

The roadways in study areas included two-lane paved road. Four trapping belts with 10 m-width and 200 m-length were established in both sides of a road. Two trapping belts are located on 10 m away from road ridge and the others are on 70 m away. Each trapping belt involved 10 trapping stations. Trapping stations within each belt were located 20 m distance. Snap traps baited with peanut were placed at the 'best' or 'most likely' spot for capturing small rodents, i.e. at base of tree, near logs, near tunnels, near rock, in runways through vegetation, within 10 m radius of station (Ministry of Environment, 2003).

Table 1. Captured small rodents at the 9 study areas in Baekdudaegan mountains, Korea.

Areas	Species[1]	No. of total captured ind. (No. of juv. ind.)	Sex ratio (M : F)	Mean body weight (g)
Hangyeryeong	Ap	9 (6)	6 : 3	28.9
Dakmogryeong	Aa	4 (1)	2 : 2	33.5
Daetjae	Aa	1 (0)	1 : 0	34.7
Doraegijae	Ap	3 (1)	1 : 2	34.0
	Aa	2 (0)	2 : 0	34.5
Beoljae	Ap	1 (0)	0 : 1	35.0
	Aa	1 (0)	0 : 1	37.0
Bamtijae	Ap	4 (2)	2 : 2	36.4
Jilmaejae	Ap	3 (1)	2 : 1	34.7
	Aa	2 (0)	1 : 1	37.5
Sinpungryeong	Ap	4 (1)	2 : 2	37.5
	Aa	2 (1)	1 : 1	30.4
Bokseongijae	Ap	3(1)	1 : 2	33.3
	Aa	4(0)	3 : 1	37.0

[1]Species-Ap : *Apodemus peninsulae*, Aa : *Apodemus agrarius*

All captured small rodents were species identified, sexed and weighed. Also reproduction stage was recorded. Trapping was conducted during two consecutive days in September 2002, because this period is known as small rodent populations would be stable and most active in Korea (Rhim, 1997; Rhim and Lee, 1998). Daetjae and Beoljae was excluded from the analysis, because the sample size was small. Seven study areas were included for analysis (Table 1).

The road effect on two small rodents was analyzed by using the density and body condition between 10m and 70 m from road. Body condition index was simply calculated by mean body weight of captured small rodents (Rhim, 1997). Mann-Whitney U-test was used to analyze the reaction of small mammal to distance from road. Data are presented as mean±SD. In all tests, one-tailed probability is given unless stated otherwise. Alpha levels of 0.05 were considered to be statistically significant. Data were analyzed using SAS package.

Results and Discussion

Two species of small rodents, Korean field mouse *Apodemus peninsulae* and striped field mouse *Apodemus agrarius* were captured in 9 study areas. Total forty three individuals were captured in this study. Korean field mouse were captured 27 individuals and striped field mouse were 16 individuals. The percentage of juvenile individuals were 44.4% of Korean field mouse and 12.5% of striped field mouse, respectively. Sex ratio was also different in two species. Sex ratio of Korean field

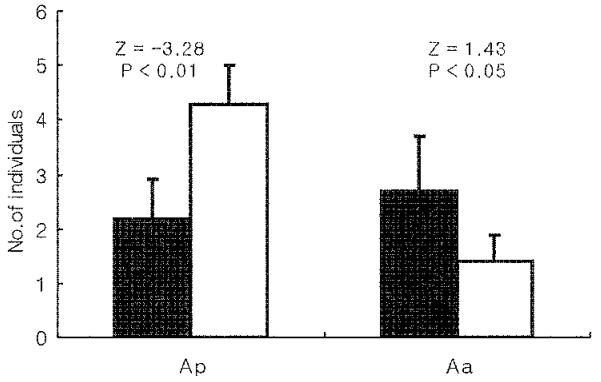

Figure 2. Differences in number of captured individuals (The bars indicated standard deviation) of Korean field mouse *Apodemus peninsulae* (Ap) and striped field mouse *Apodemus agrarius* (Aa) between 10 m (black bars) and 70 m (white bars) distance from the road.

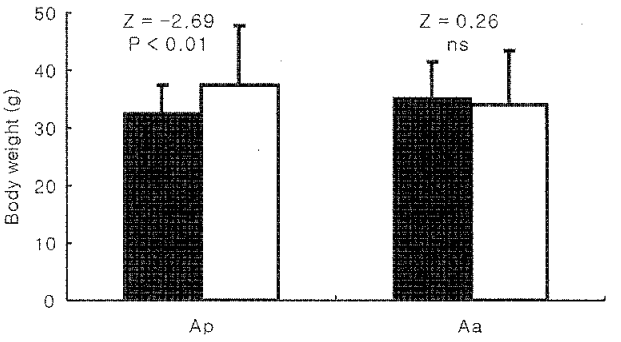

Figure 3. Differences in mean body weight (The bars indicated standard deviation) of adult individuals of Korean field mouse *Apodemus peninsulae* (Ap) and striped field mouse *Apodemus agrarius* (Aa) between 10 m (black bars) and 70 m (white bars) distance from the road.

mouse and striped field mouse were 14 : 13 (male : female) and 10 : 6, respectively. Nine individuals, the most biggest number were captured in Hangyeryeong area and 1 individual, the smallest number was in Daetjae (Table 1).

Mean number of captured individuals of Korean field mouse (Mann-Whitney U-test, $Z = -3.28$, $P < 0.01$) and striped field mouse ($Z = 1.43$, $P < 0.05$) between two distance categories were different. Korean field mouse was more abundant in 70 m distance (4.3 ± 0.6, mean$\pm$ SD) than 10 m distance (2.2 ± 0.7) from road. Striped field mouse was more abundant in 10m distance (2.7 ± 1.1) than 70 m distance (1.4 ± 0.5) from road (Figure 2).

Mean body weight of Korean field mouse was significantly different between two distance categories ($Z = -2.69$, $P < 0.01$). Mean body weight was more heavier in 70m distance (37.4 ± 10.2) than in 10m distance (32.6 ± 4.7) from road. Mean body weight of striped field mouse ($Z = 0.26$, $P > 0.1$) between 10m (35.1 ± 9.5) and 70 m (33.9 ± 6.4) from road were not significantly different (Figure 3).

Many authors reported that small rodents were more abundant on road verge (Bellamy *et al.*, 2000). But results of research would be different in the condition of habitats as grassland, cultivated area and forest. Grassland dwelling species prefers road verge, while forest dwelling species does interior forest (Williams *et al.*, 2002).

According to our results, Korean field mouse seems to be sensitive to the existence of road. This species prefers 70m distance to 10m distance from the road (Figure 2). And body condition was better interior forest area than around road (Figure 3). Korean field mouse is forest-inhabiting species distributing limitedly in forest area (Won, 1967; Rhim, 1997; Rhim and Lee, 2001). Habitat condition and quality around road would be not good for this species.

Striped field mouse was more abundant 10m distance than 70 m distance from the road (Figure 2), but body condition was not different (Figure 3). Striped field mouse is habitat generalist, because this species occur in from bottom to summit of mountain, forest edge and cultivated areas (Won, 1967). This species may less sensitive to the existence of road than Korean field mouse.

The influence of road on small rodents would be different in each species and their habitat using pattern (Bellamy *et al.*, 2000). A road transforms the physical conditions on and adjacent to it, creating edge effects with consequences that extend beyond the time of road's construction (McGarigal *et al.*, 2001). Some species would be more abundant and distributed more wider ranges. Further studies would be needed to identify the effect on food preferences, predation pressure and habitat using pattern based on detailed micro-habitat preferences of small rodents caused by road construction.

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