



## The Fauna of Ground Beetles (Coleoptera, Carabidae) in Mt. Gariwang and Comparison with Neighboring Taebaek Mountains, Gangwon-do, Korea

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**Abstract:** The study was performed to compare a list of ground beetles at Mt. Gariwang in Pyeongchang, Gangwon-do and their previous distribution in nearby places, as well as provide fundamental information on community structure and diversity of ground beetles. A total of 15 species belonging to 8 genera of 4 subfamilies were identified from 244 collected ground beetles in Mt. Gariwang. Nine species of Pterostichinae and 4 Carabinae species were collected the most and the abundance of *Pterostichus* and *Synuchus* genus were 89 and 83, respectively. The dominant species were *Synuchus* sp. (64 individuals, 26.2%) and *Eucarabus cartereti cartereti* (40 individuals, 16.4%). The Korean endemic species were 98 individuals of 6 species. The ground beetles at mountainous areas in Pyeongchang, Inje, Wonju and Taebaek from the Taebaek Mountains including Mt. Odae, Mt. Chiak, Mt. Gyebang, Mt. Jeombong, Mt. Taebaek, Mt. Balwang and Mt. Bangtae are identified in 140 species belonging to 51 genera of 15 subfamilies. The study is expected to provide important information on distribution of ground beetles in monitoring long-term changes in biofaces around the Taebaek Mountains.

**Keywords:** Carabidae, monitoring, inventory, Mt. Gariwang, Taebaek Mountains

### Introduction

Mountainous areas have very high biodiversity due to small environmental disturbance and habitat for many creatures, considered as a very important ecosystem for many local unique species and conserving biodiversity (Lomolino, 2001). Recently, increasing human activities have damaged or disturbed habitats and caused separation or climate change and this has led the Korea National Parks Authority, National Institute of Natural Resources and National Science Museum to conduct biota monitoring and investigate natural resources to secure local natural resources and acquire fundamental information. The information on biodiversity in mountainous areas is required to conserve biota in the aspect of effective management and usage of bioresources, as well as distribution or density changes.

Most ground beetles except Halpalinae and Zabrinae are predaceous and natural enemy of small-sized invertebrates including earthworms, aphids, moths and snails, play a very important role in the ecosystem (Lövei and Sunderland, 1996; Holland, 2002) and this considers ground beetles as

an important natural enemy group in mountainous areas and agricultural environment (Kromp, 1999; Holland, 2002). Also, it was reported that Carabinae and Pterostichinae with less mobility due to wing atrophy in hind wings (Lövei and Sunderland, 1996) would be decreased diversity due to separation and changes in their habitats (Niemelä *et al.*, 2000). These various ecological and biological features make ground beetles a proper group as biological indicators (Thiele, 1977; Lövei and Sunderland, 1996; Pearce and Venier, 2006) and the pitfall trap is standardized and widely used due to providing qualitative comparison analysis among study sites and statistical and scientific results (Southwood, 1978; Lövei and Sunderland, 1996; Niemelä *et al.*, 2000). However, there are few researches on distribution or ecological roles of ground beetles, important players in the ecosystem, in Korea.

Only *Parena perforata* was recorded as ground beetles in Mt. Gariwang (Park and Paik, 2001), there were several researches in nearby Mt. Odae (Kim and Kim, 1971; Kwon and Byun, 1996; Kim and Kim, 1998), Mt. Chiak (Kim and Kim, 1976), Mt. Gyebang (Kim and Nam, 1982), Mt. Jeombong (Kim and Nam, 1984), Mt. Taebaek (Kim and Chang, 1987), Mt. Balwang (Park and Han, 1992) and Mt. Bangtae (Kim, 1995; Kim and Kim, 1996, Jung *et al.*, 2011) by performing local researches and additional

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researches by Park *et al.* (1996), Park and Kwon (1996a, 1996b, 1996c, 1996d), Park and Paik (2001) and Park (2004) provide collected records. Therefore, the study was performed to make specific inventories of ground beetles in Mt. Gariwang and to provide fundamental information and diversity on community structure of ground beetles by comparing to previous records in nearby mountainous areas.

## Materials and Methods

### Study area

The mountain is located 128°33'57" east longitude and 37°27'31" north latitude, on the boundary between Bukmyeon, Jeongseon-eup, Jeongseon-gun and Jinbu-myeon, Pyeongchang-gun, has 1,561 m height, placed at the center of the Taebaek Mountains and surrounded by Mt. Jungwang (1,371 m) and Mt. Balwang (1,458 m) in the west, Mt. Cheongok (1,256 m) in the southwest and Jungbong and Habong (1,433 m) in the southeast and Mt. Mindun (995 m). The vertical vegetation structure of the Mt. Gariwang between 550 and 1,500 m is height features subalpine plants and various vegetation structure. Natural forests include dominant *Quercus mongolica* and deciduous trees including *Betula costata*, *Acer pictum*, *Tilia amuerensis*, *Ulmus davidiana* var. *japonica*, *Fraxinus mandshurica*,

*Kalopanax septemlobus* and there are some coniferous trees including *Abies holophylla*, *Abies nephrolepis* and *Taxus cuspidata* in some places higher than 1,000m above the sea level (Baek *et al.*, 1998, Korea Forest Service, 1990, 1991). The climate zone is included in central and northern temperate zone, the average temperature at 1,200 m ranges -0.4 to 18.6°C, 1.1-20.2°C at 1,000 m and 1.6-20.7°C at 750 m. The annual average relative humidity of the mountain records 73.1% (Korea Forest Service, 1992, 1999). Three are designated in Jangjeon and Makdong valleys in the mountain to investigate ground beetles (Fig. 1) and the information in habitats for each are shown in Table 1.

### Collecting method

Ground beetles mainly live on the surface and pitfall traps are installed considering these features. There are 3 traps at 10 m interval for each and the top of the trap is placed with the same height of the surface. Transparent plastic bottles with 10.5 cm height, 8 cm diameter and 500 mL volume were used as traps and had plastic filters with 6 holes at 2 cm diameter to protect from mid- and large-sized animals like rodents or reptiles plastic covers at 5 cm from the top to prevent rainwater from entering the trap. Ethyl-alcohol and Ethylene-glycol with 1 : 1 ratio was used as conservative solution to protect samples. A total of 3 investigation were performed from July to September, 2009.

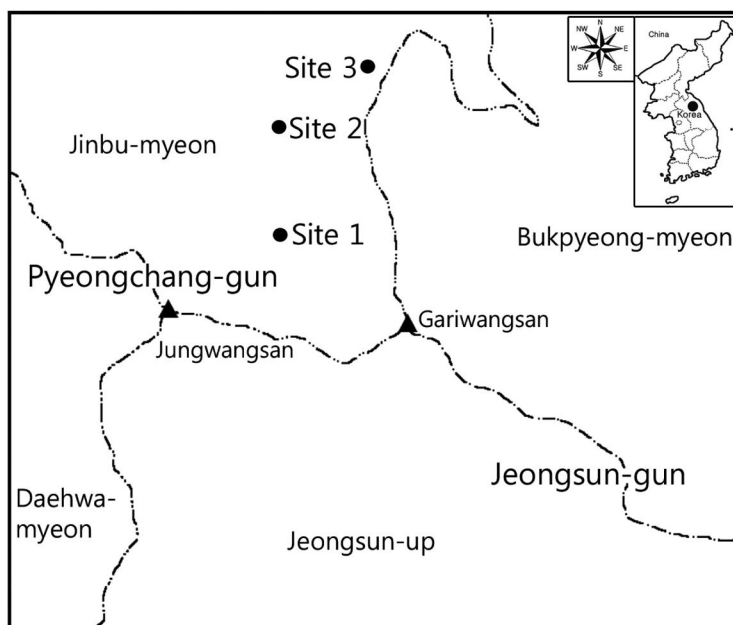


Fig. 1. Location of survey sites in Mt. Gariwang, Gangwon-do.

Table 1. Habitat environment and location of each survey site

Site	Habitat environment	Location (Pyeongchang-gun)	Latitude	Longitude	Altitude (m)
1	Deciduous forest		37°28'36"	128°32'33"	707
2	Mixed forest	Jangjeon-ri	37°29'16"	128°32'37"	628
3	Forest nearby Jangjeon valley in mountain border	Jangjeon valley entrance in Makdong-ri	37°30'01"	128°33'47"	485

**Identification**

Collected ground beetles were identified to species using dissecting microscopes (Nikon smz800) (Habu, 1967; 1973; 1978; Kwon and Lee, 1984; Park and Kwon, 1996; Park et al., 1996; Sasakawa et al., 2006), species names follow Park and Paik (2001) and Park (2004) and species requiring additional taxonomical reviews were identified to genus level. The collected samples during the study were treated by dried and 80% Ethyl-alcohol samples and stored in the Insect Ecology Laboratory of Seoul National University.

**Community structure analysis**

Species richness, abundance, Shannon-Wiener’s diversity ( $H'$ , Shannon and Weaver, 1949) and Simpson’s dominant index ( $D$ , Simpson, 1949) were calculated and the formulas are as follows:

$$H' = -\sum p_i \log(p_i)$$

$$D = \sum p_i^2$$

$p_i$  means  $n_i/N$ ,  $n_i$  means number of individuals at  $i$ -th species and  $N$  means total number of individuals. PRIMER ver. 6, community analysis program, was used to calculate species diversities (Clarke and Gorley, 2006).

**Comparative study with previous studies in Taebaek Mountains, Gangwon-do**

There were no previous research record except one by Park and Paik (2001) in Mt. Gariwang, causing to compare research results for nearby mountains. Mt. Gariwang is in the Taebaek Mountains, shows high biodiversity and is

surrounded by Mt. Gyebang (1,577), Mt. Odae (1,563 m), Mt. Balwang (1,458 m), Mt. Chiak (1,288 m) and Mt. Taebaek (1,567 m). Mt. Bangtae (1,435 m), Mt. Jeombong (1,424 m) and Mt. Seorak (1,708 m) are placed in the north, as well as the Taebaek Mountains. To make an integrated list of ground beetles in the region, papers (Kim and Kim, 1971; Kim and Kim, 1976; Kim and Nam, 1982; Kim and Nam, 1984; Kim and Chang, 1987; Park and Han, 1992; Kim, 1995; Kim and Kim, 1996; Kwon and Byun, 1996; Kim and Kim, 1998; Jung et al., 2011) and collected records (Park et al., 1996; Park and Kwon, 1996a, 1996b, 1996c, 1996d; Park and Paik, 2001; Park, 2004) were cited. In the process, species not existed in Park and Paik (2001) and Park (2004) lists and unidentified species considering identification uncertainty were excluded and distribution was compared for previous ground beetles.

**Results and Discussion**

**Community structure in Mt. Gariwangsan**

A total of 15 species belonging to 8 genera of 4 subfamilies were identified from 244 collected ground beetles in Mt. Gariwang (Table 2). Eight species of Pterostichinae recorded the highest number of subfamily species, followed by and 4 Carabinae and 1 Harpalinae and 1 Brachininae (Fig. 2). At the genus level, 89 individuals of *Pterostichus* and 83 individuals of *Synuchus* genus were collected, followed by *Eucarabus* and *Coptolabus* for 40 and 19, respectively (Fig. 3). Only 1 *Harpalus* genus, mainly collected in grasslands, was discovered with 1 individual under 1 species. The dominant species were *Synuchus* sp. (64 individuals, 26.2%) and *Eucarabus cartereti cartereti*

**Table 2.** List of ground beetles in Mt. Gariwang

Korean name	Scientific name	Site			Total
		1	2	3	
<b>딱정벌레아과</b>	<b>Subfamily Carabinae</b>				
민줄딱정벌레	<i>Aulonocarabus semiopacus</i>	3	3	2	8
강원멋쟁이딱정벌레	<i>Coptolabus jankowskii taebaegsanensis</i>	5	13		18
진홍단딱정벌레	<i>Coptolabus smaragdinus branickii</i>		1		1
강원우리딱정벌레	<i>Eucarabus cartereti cartereti</i>	22	11	7	40
<b>길쭉먼지벌레아과</b>	<b>Subfamily Pterostichinae</b>				
만주애납작먼지벌레	<i>Pristosia vigil</i>	1	1		2
수도길쭉먼지벌레	<i>Pterostichus audax</i>	5	10	2	17
반디길쭉먼지벌레	<i>Pterostichus ishikawai</i>	3	5	6	14
동양길쭉먼지벌레	<i>Pterostichus orientalis orientalis</i>	3	9		12
<i>Pterostichus (Koreonialoe) sp.1</i>	<i>Pterostichus (Koreonialoe) sp.1</i>	16	12	8	36
<i>Pterostichus (Koreonialoe) sp.2</i>	<i>Pterostichus (Koreonialoe) sp.2</i>	6	4		10
붉은칠납작먼지벌레	<i>Synuchus cycloderus</i>	1	8	4	13
윤납작먼지벌레	<i>Synuchus nitidus</i>		5	1	6
<i>Synuchus</i> sp.	<i>Synuchus</i> sp.	5	25	34	64
<b>먼지벌레아과</b>	<b>Subfamily Harpalinae</b>				
영실머리먼지벌레	<i>Harpalus pseudophonoides</i>			1	1
<b>폭탄먼지벌레아과</b>	<b>Subfamily Brachininae</b>				
꼬마목가는먼지벌레	<i>Brachinus stenoderus</i>	1	1		2

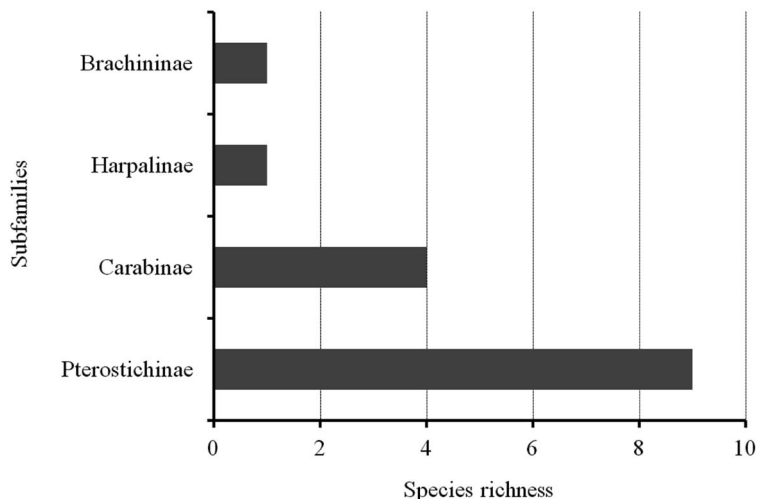


Fig. 2. Species richness of each subfamily.

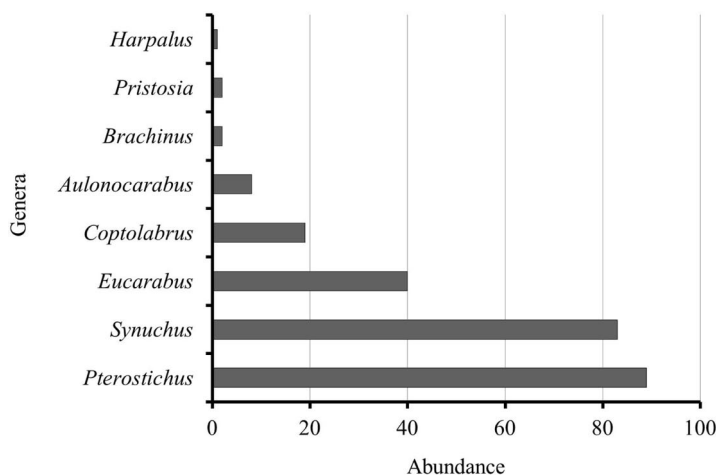


Fig. 3. Abundance of each genus.

(40 individuals, 16.4%).

In the aspect of diversities for site, mid-altitude area with mixed forests (site 2) showed highest species richness, abundance, Shannon’s index ( $H'$ ) and Simpson’s dominance index ( $D$ ) and low-altitude area with deciduous trees (site 3) shows the lowest diversity (Table 3). As higher altitude, 12, 14 and 9 species were collected, meaning that the largest number of species appeared at the height of 628 m (site 2).

**Endemic species**

The endemic species of ground beetles in Mt. Gariwang include *Aulonocarabus semiopacus* (3 site, 8 individuals), *Coptolabrus jankowskii taebegsanensis* (2 site, 18 individuals), *Coptolabrus smaragdinus branickii* (1 site, 1 individual), *E. c. cartereti* (3 site, 40 individuals), *Pterostichus audax* (3 site, 17 individuals), *Pterostichus ishikawai* (3 site, 14 individuals), showing 198 individuals under 6 endemic species (Table 2, Fig. 4). *Pterostichus (Koreonialoe)* spp. was excluded from the endemic species due to unidentified species.

Table 3. Community structure of ground beetles in each site

Site	Subfamily	Genus	Species richness	Abundance	$H'$	$D$
1	3	7	12	71	2.071	0.168
2	3	7	14	108	2.327	0.119
3	4	6	9	65	1.571	0.315

Compared to lowland, mountainous areas are isolated from the places and show more endemic species (Lomolino, 2001) and the endemic species in the areas showed 6 species (40.0%) and 98 individuals (40.2%) among 15 species and 244 individuals.

**Comparative study with previous studies on Taebaek Mountains**

As a result of comparative study to previous researches on mountainous areas in Gangwon-do, the total number of ground beetles in 9 mountainous areas including Mt. Gariwang was 140 species belonging to 51 genera of 15 subfamilies and the lists are represented in Appendix 1. The

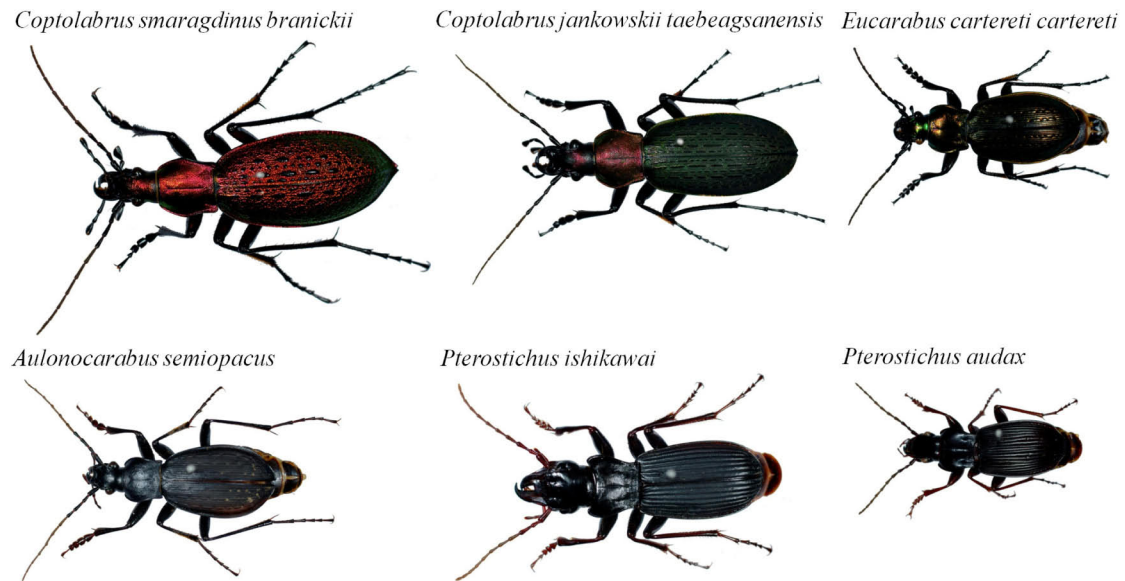


Fig. 4. Photos of Korean endemic carabids.

distribution of ground beetles in mountainous areas showed that *Parena perforata* was collected only in Mt. Gariwang and Mt. Bangtae (12 common species) and Mt. Gyebang (3 common species) had the most similar aspects of ground beetles in the Mt. Gariwang (Appendix 1). The reason why there were small common species from previous records and Mt. Gariwang in Gangwon-do is that light traps or sweepings were used in the past, limited collection of ground beetles running on the surface and the research implemented research and collection methods the same with Jung *et al.* (2011), showing the most similar community structure of ground beetles with that of Mt. Bangtae.

Subfamily species for each area showed Pterostichinae (40 species, 28.6%), Harpalinae (25 species, 17.9%), Carabinae (21 species, 15.0%), Lebiinae (15 species, 10.7%) (Fig. 5). Pterostichinae and Carabinae take the major group of ground beetles in mountainous areas. However, Harpalinae, hard to be found out in forests, appeared so much in previous studies because sweeping and light traps made it possible to collect inside forests, as well as grasslands.

In conclusion, ground beetles show distinct distribution depending microenvironment and habitats (Thiele 1977; Lövei and Sunderland, 1996) and considering these features may provide more reasonable analysis and comparison tools to make inventories and long-term monitoring in a certain area. In particular, Pterostichinae and Carabinae show high rates of endemic species and brachypterous features with atrophy of hind wings, low mobility and distributional power and are expected to be largely affected by disturbance and fragmentation of habitats, considering it shall be included in the environment monitoring in mountainous areas.

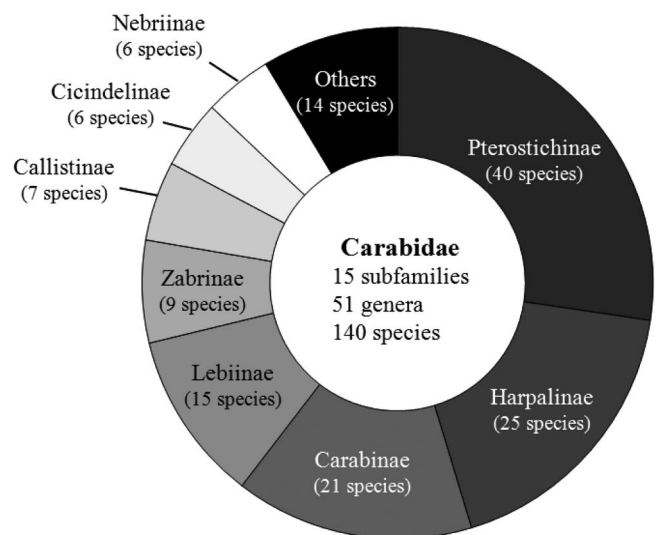


Fig. 5. Species richness of Carabidae with previous studies on mountains in Taebaek Mountains, Gangwon-do.

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Appendix 1. Ground beetles of mountains in Taebaek Mountains

Subfamily	Korean name	Scientific name	Mountain								
			Gariwang <sup>1</sup>	Gyeong <sup>2</sup>	Balgwang <sup>3</sup>	Bangtae <sup>4</sup>	Seolak <sup>5</sup>	Odae <sup>6</sup>	Jeombong <sup>7</sup>	Chiak <sup>8</sup>	Taebaek <sup>9</sup>
Cicindelinae	주홍길앞잡이	<i>Cicindela coerulea shantungensis</i>							○		
	아이누길앞잡이	<i>Cicindela gemmata</i>							○		○
	좀길앞잡이	<i>Cicindela japana</i>				○					○
	큰무늬길앞잡이	<i>Cicindela lewisi</i>							○		
	산길앞잡이	<i>Cicindela sachalinensis</i>				○			○		
	뜰길앞잡이	<i>Cicindela transbaicalica japonensis</i>							○		
Carabinae	조롱박딱정벌레	<i>Acoptolabrus constricticollis constricticollis</i>							○		
	윤조롱박딱정벌레	<i>Acoptolabrus leechi yooni</i>						○			
	오대멋조롱박딱정벌레	<i>Acoptolabrus mirabilissimus furumiensis</i>							○		
	멋조롱박딱정벌레	<i>Acoptolabrus mirabilissimus mirabilissimus</i>							○		○
	북방줄딱정벌레	<i>Aulonocarabus careniger careniger</i>				○					
	고려줄딱정벌레	<i>Aulonocarabus koreanus koreanus</i>						○	○		○
	청진민줄딱정벌레	<i>Aulonocarabus seishinensis seishinensis</i>				○			○		○
	민줄딱정벌레	<i>Aulonocarabus semiopacus</i>	○						○		
	검정명주딱정벌레	<i>Calosma maximowiczi</i>							○		
	백두산딱정벌레	<i>Carabus arvensis faldermanni</i>							○		
	강원멋쟁이딱정벌레	<i>Coptolabrus jankowskii taebaegsanensis</i>	○	○		○			○	○	○
	진홍단딱정벌레	<i>Coptolabrus smaragdinus branickii</i>	○	○	○	○			○		○
	중두꺼비딱정벌레	<i>Coreocarabus fraterculus affinis</i>							○		
	납두꺼비딱정벌레	<i>Coreocarabus fraterculus assimilis</i>									○
	두꺼비딱정벌레	<i>Coreocarabus fraterculus fraterculus</i>							○		○
	산우리딱정벌레	<i>Eucarabus angustus</i>							○		
	강원우리딱정벌레	<i>Eucarabus cartereti cartereti</i>	○							○	○
	애딱정벌레	<i>Hemicarabus tuberculosus</i>				○			○		
	오대애기맷시딱정벌레	<i>Leptinocarabus wulffiusi odaesamus</i>							○		
산애기맷시딱정벌레	<i>Leptinocarabus wulffiusi taebaegsamus</i>									○	
애기맷시딱정벌레	<i>Leptinocarabus wulffiusi wulffiusi</i>							○			
Omophroninae	강변먼지벌레	<i>Omophron aequalis jacobsoni</i>								○	
Nebriinae	애가슴먼지벌레	<i>Leistus niger niger</i>							○		
	압록가슴먼지벌레	<i>Nebria komarovi</i>						○	○	○	
	중국먼지벌레	<i>Nebria chinensis chinensis</i>								○	
	고려먼지벌레	<i>Nebria coreica</i>						○			
	노랑선두리먼지벌레	<i>Nebria livida angulata</i>				○					
	검정가슴먼지벌레	<i>Nebria ochotica</i>							○		
Scaritinae	알가슴먼지벌레	<i>Dyschiriodes aeneus</i>				○					
Broscinae	딱정벌레붙이	<i>Craspedonotus tibialis</i>						○	○		
Bembidiinae	별강먼지벌레	<i>Bembidion scopulinum</i>				○				○	
	넉점포마강변먼지벌레	<i>Tachyura laetifica</i>				○					
Patrobinae	사개천먼지벌레	<i>Diplous depressus</i>							○		
	얇은습지먼지벌레	<i>Patrobus ambiguus</i>							○		
	습지먼지벌레	<i>Patrobus flavipes</i>							○		
	깊은습지먼지벌레	<i>Patrobus shorengensis</i>							○		
Pterostichinae	꼬마납작먼지벌레	<i>Agonum leucopus</i>				○				○	
	줄납작먼지벌레	<i>Colpodes adonis</i>				○		○			
	검정끝가시먼지벌레	<i>Colpodes atricomus</i>				○		○			
	날개끝가시먼지벌레	<i>Colpodes buchanani</i>				○	○	○	○	○	
	일본줄납작먼지벌레	<i>Colpodes japonicus</i>				○				○	
	애기줄납작먼지벌레	<i>Colpodes speculator</i>				○					
	큰줄납작먼지벌레	<i>Colpodes sylphis stichai</i>						○			
	납색납작먼지벌레	<i>Dicranoncus femoralis</i>				○	○	○		○	
	동맹간먼지벌레	<i>Dolichus halensis halensis</i>		○		○	○	○	○	○	
	동양납작먼지벌레	<i>Euplynes batesi</i>				○					
	금빛먼지벌레	<i>Poecilus coerulescens encopoleus</i>				○		○			
	왕금빛먼지벌레	<i>Poecilus fortipes</i>				○		○		○	
	우리금빛먼지벌레	<i>Poecilus nemotoi</i>						○	○	○	

Appendix 1. Continued

Subfamily	Korean name	Scientific name	Mountain								
			Gariwang <sup>1</sup>	Gyeong <sup>2</sup>	Balwang <sup>3</sup>	Bangtae <sup>4</sup>	Seolak <sup>5</sup>	Odae <sup>6</sup>	Jeombong <sup>7</sup>	Chiak <sup>8</sup>	Taebaek <sup>9</sup>
	만주에납작먼지벌레	<i>Pristosia vigil</i>	○				○	○			○
	가시길쭉먼지벌레	<i>Pterostichus acuspinus</i>						○			
	장군길쭉먼지벌레	<i>Pterostichus apiculatiphallus</i>									○
	수도길쭉먼지벌레	<i>Pterostichus audax</i>	○					○	○		○
	청암길쭉먼지벌레	<i>Pterostichus bellator bellator</i>						○	○		○
	강원길쭉먼지벌레	<i>Pterostichus bifidifallus</i>	○					○	○		
	꼬마길쭉먼지벌레	<i>Pterostichus bifoveolatus</i>							○		
	반디길쭉먼지벌레	<i>Pterostichus ishikawai</i>	○						○		○
	조계길쭉먼지벌레	<i>Pterostichus jogaesanensis</i>						○			
	우리길쭉먼지벌레	<i>Pterostichus kurosai</i>							○		
	잔머리먼지벌레	<i>Pterostichus microcephalus</i>						○	○		○
	동양길쭉먼지벌레	<i>Pterostichus orientalis orientalis</i>	○								
	가슴길쭉먼지벌레	<i>Pterostichus praedo</i>						○	○		○
	참길쭉먼지벌레	<i>Pterostichus prolongatus</i>							○		
	이사길쭉먼지벌레	<i>Pterostichus scurrus</i>						○	○		○
	승락길쭉먼지벌레	<i>Pterostichus seunglaki</i>						○	○		
	승모길쭉먼지벌레	<i>Pterostichus seungmoi</i>		○							○
	탐라길쭉먼지벌레	<i>Pterostichus solskyi</i>						○			○
	등글길쭉먼지벌레	<i>Pterostichus subovatus</i>		○		○			○		○
	팬다리길쭉먼지벌레	<i>Pterostichus sulcitaris</i>							○		
	태백길쭉먼지벌레	<i>Pterostichus taebaegsanus</i>									○
	둥근칠납작먼지벌레	<i>Synuchus arcuaticollis</i>	○								
	칠납작먼지벌레	<i>Synuchus chabo</i>							○		
	붉은칠납작먼지벌레	<i>Synuchus cycloderus</i>	○					○	○		
	검정칠납작먼지벌레	<i>Synuchus melantho</i>				○	○				
	윤납작먼지벌레	<i>Synuchus nitidus</i>	○								○
	한국길쭉먼지벌레	<i>Trigonognatha coreana</i>				○			○		
Harpalinae	점박이먼지벌레	<i>Anisodactylus punctatipennis</i>				○					○
	먼지벌레	<i>Anisodactylus signatus</i>				○	○	○			○
	에먼지벌레	<i>Anisodactylus tricuspoidatus</i>					○				
	노란테먼지벌레	<i>Anoplogenius cyanescens</i>				○					
	노란목좁쌀에먼지벌레	<i>Bradycellus laeticolor</i>				○					
	애기민머리먼지벌레	<i>Harpalus bungii</i>					○				○
	머리먼지벌레	<i>Harpalus capito</i>					○				
	가는청둥머리먼지벌레	<i>Harpalus chalcentus</i>		○			○	○			
	고려머리먼지벌레	<i>Harpalus coreanus</i>						○			
	검은머리먼지벌레	<i>Harpalus corporosus</i>					○	○			○
	일본머리먼지벌레	<i>Harpalus discrepans</i>						○			○
	가슴털머리먼지벌레	<i>Harpalus eous</i>					○	○			
	씨앗머리먼지벌레	<i>Harpalus griseus</i>						○	○		○
	수염머리먼지벌레	<i>Harpalus jureceki</i>					○		○		
	참머리먼지벌레	<i>Harpalus niigatamus</i>						○			
	알락머리먼지벌레	<i>Harpalus pallidipennis</i>					○				
	영실머리먼지벌레	<i>Harpalus pseudophonoides</i>	○								
	설악머리먼지벌레	<i>Harpalus roninus</i>						○			○
	중국머리먼지벌레	<i>Harpalus sinicus sinicus</i>							○		
	꼬마머리먼지벌레	<i>Harpalus tridens</i>						○	○		
	만주머리먼지벌레	<i>Harpalus tschiliensis</i>							○		
	북방머리먼지벌레	<i>Harpalus vicarius</i>						○			
	초록좁쌀먼지벌레	<i>Stenolophus difficilis</i>						○			○
	붉은가슴좁쌀먼지벌레	<i>Stenolophus propinquus</i>									○
	윤머리먼지벌레	<i>Trichotichus leptopus</i>						○			
Zabrinae	등글먼지벌레	<i>Amara chalcites</i>				○					
	애등글먼지벌레	<i>Amara chalcophaea</i>							○		
	어리등글먼지벌레	<i>Amara congrua</i>					○	○	○		○
	일본등글먼지벌레	<i>Amara lucidissima</i>					○				○
	사천등글먼지벌레	<i>Amara obscuripes</i>						○			



Appendix 1. Continued

Subfamily	Korean name	Scientific name	Mountain									
			Gariwang <sup>1</sup>	Gyebang <sup>2</sup>	Balwang <sup>3</sup>	Bangtae <sup>4</sup>	Seolak <sup>5</sup>	Odae <sup>6</sup>	Jeombong <sup>7</sup>	Chiak <sup>8</sup>	Taebaek <sup>9</sup>	
	애기둥글먼지벌레	<i>Amara simplicidens</i>						○				○
	큰둥글먼지벌레	<i>Curtonotus giganteus</i>					○					
	울릉둥글먼지벌레	<i>Curtonotus hiogoensis</i>								○		
Callistinae	줄먼지벌레	<i>Chlaenius costiger</i>										○
	끝무늬먼지벌레	<i>Chlaenius micans</i>					○					
	쌍무늬먼지벌레	<i>Chlaenius naeviger</i>			○	○						○
	민무늬먼지벌레	<i>Chlaenius ocreatus</i>						○				○
	풀색먼지벌레	<i>Chlaenius pallipes</i>			○	○	○	○				
	노랑무늬먼지벌레	<i>Chlaenius posticalis</i>					○	○				○
	미륵무늬먼지벌레	<i>Chlaenius variicornis</i>					○					
Panagaeinae	네눈박이먼지벌레	<i>Panagaeus japonicus</i>					○					
Lebiinae	녹색먼지벌레	<i>Calleida onoha</i>								○		
	가슴점박이먼지벌레	<i>Cymindis collaris</i>					○					
	밑빠진먼지벌레	<i>Cymindis daimio</i>					○					
	애밑빠진먼지벌레	<i>Cymindis vaporarioorum immaculatus</i>						○				
	파랑선두리먼지벌레	<i>Dromius prolixus</i>								○		
	목가는먼지벌레	<i>Galerita orientalis</i>								○		
	노랑가슴먼지벌레	<i>Lachnolebia cribricollis</i>						○	○			○
	쌍점십자무늬먼지벌레	<i>Lebia bifenestrata</i>										○
	십자무늬먼지벌레	<i>Lebia cruxminor</i>								○		
	한라십자무늬먼지벌레	<i>Lebia retrofasciata</i>						○	○			
	팔점박이먼지벌레	<i>Lebidia octoguttata</i>						○				○
	넙점선두리먼지벌레	<i>Parena perforata</i>	○									
	석점선두리먼지벌레	<i>Parena tripunctata</i>						○	○		○	○
	육모먼지벌레	<i>Pentagonica daimiella</i>						○	○			○
	두점박이먼지벌레	<i>Planetes puncticeps</i>										○
Brachininae	꼬마목가는먼지벌레	<i>Brachinus stenoderus</i>	○	○	○	○	○	○	○			
	폭탄먼지벌레	<i>Pheropsophus jessoensis</i>									○	○

\*added ground beetle species on the list from previous studies on neighboring mountains in Taebaek Mountain, Gangwon-do, Korea.

<sup>1</sup>Park and Paik (2001), Present study

<sup>2</sup>Kim and Nam (1982), Park and Paik (1996b), Park and Paik (2001)

<sup>3</sup>Park and Han (1992)

<sup>4</sup>Kim (1995), Kim and Kim (1996), Park and Paik (2001), Jung et al.(2011)

<sup>5</sup>Park and Kwon (1996a, 1996d, 1996c), Park and Paik (2001), Park (2004)

<sup>6</sup>Kim and Kim (1971), Kim and Kim (1998), Park and Kwon (1996a, 1996d, 1996c), Park et al. (1996), Park and Paik (2001), Park (2004)

<sup>7</sup>Kim and Nam (1984)

<sup>8</sup>Kim and Kim (1976), Park and Kwon (1996a, 1996d), Park and Paik (2001)

Kim and Chang (1987), Park and Kwon (1996a, 1996d, 1996b), Park and Paik (2001), Park (2004)