

Tree Species Preferred as Fecal Sites by the Siberian Flying Squirrel *Pteromys volans*

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Abstract

Fecal sites of the Siberian flying squirrel *Pteromys volans* were found in the 16 tree species, and 11 species (46.4%) of them were used as fecal sites in winter and only 3 tree species (5.6%) were used for their fecal dropping in summer. In winter and spring, 11 and 10 tree species were used as fecal sites, respectively, indicating that various species of trees are used in those seasons for food sources or resting sites of the flying squirrels. Of total 16 species, the flying squirrels' fecal sites were most frequently found in *Quercus mongolica* (46.4%) and then followed by *Prunus sargentii* (25.6%). In winter, *Prunus sargentii* was preferred more than *Quercus mongolica*, although trees of *Prunus sargentii* are less distributed compared with those of various trees of the genus *Quercus*. In summer and autumn, high productivity of trees makes the flying squirrels use only one or two species they prefer. In winter and spring, however, they should extend their food source to various tree species because of low productivity and less food sources.

Key Words: flying squirrel, fecal site, *Quercus mongolica*, *Prunus sargentii*

Introduction

Siberian Flying squirrels of *Pteromys volans* are the only nocturnal tree squirrel and the smallest of all squirrels. They are widely distributed in forests of Finland to Eurasia (Ognev 1966; Hanski and Selonen 2009; Jackson and Schouten 2012). However, it has been reported that they disappeared in northern Finland, Sweden and Poland (Kaikusalo 1973; Hokkanen et al. 1977; Gorner and Hacethal 1987; MacDonald and Barrett 1993; Hokkanen 1996; Airapetyants and Fokin 2003). In Russia near Finland, population size of the flying squirrels has also been

decreased because deforestation by cutting down trees cleared essential habitats on a massive scale (Airapetyants and Fokin 2003).

In South Korea, the flying squirrels (*P. volans*) were found in natural forests or artificial forests which are over 20 years after planting. They were distributed in only limited forests of the mainland except for islands like Jeju-do and Ulreung-do (Yoon et al. 2004; National Institute of Biological Resources 2017). Habitats or territory of the flying squirrels might be affected by broad leaf trees or coniferous trees, which are able to contribute as food source trees over every season, and resting trees like Korean Aspen

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(*Populus davidiana*). The flying squirrels drop their feces on ground under food source trees (Airapetyants and Fokin 2003).

In South Korea, since the flying squirrels were and live in only limited forests, their behavior or ecological characteristics were poorly investigated. Thus, studies on their ecological characteristics like preferred trees was little conducted. The flying squirrels excrete their feces under trees which they rest or use as their food sources. In the present study, the preferred fecal sites and trees were investigated based on the fecal sampling.

Materials and Methods

Field survey

Fecal traces of the flying squirrels were investigated during the period of 2009 to 2014. Fecal samples were found at 125 sites of 19 places including 9 places in Gangwon province (Yanggu, Inje, Yangyang, Hoeseong, Pyeongchang, Wonju, Jeongseon, Samcheok and Yeongwol), 4 places in Gyeonggi province (Pocheon, Dongducheon, Yangju and

Yangpyeong), 4 places in Gyeongsangbuk province (Uljin, Mungyeong, Sangju and Ulju), one place in Chungcheongbu province (Danyang) and one place in Jeollabuk province (Jeongeup) (Fig. 1). Places for the fecal samples were indicated by city or county level. The 4 places of Gangwon province (Yangyang, Wonju, Heoseong, and Jeongsun) were surveyed by each season, but the other places were surveyed randomly without consideration of seasons (Table 1).

Survey method and analysis

To find traces of the flying squirrels, their feces or burrows were investigated by walking along mountainous valleys or ridges. Seasons were discriminated as spring (March to May), summer (June to August), autumn (September to November) and winter (December to February of next year). The tree species which fecal samples were found were identified by Colored Flora of Korea (Lee 1999) and Korea National Arboretum (2018) using their bark, leaf or berries.

Results and Discussion

The flying squirrels excrete their feces on ground under the trees used for food sources or burrows (Airapetyants and Fokin 2003). In this study, the flying squirrels' feces were found in the 16 tree species, and 11 species (46.4%) of them were used as fecal sites in winter and only 3 tree species (5.6%) were used for their fecal dropping in summer (Table 1). In winter and spring, 11 and 10 tree species were used as fecal sites, respectively, indicating that various species of trees are used in those seasons for food sources or resting sites of the flying squirrels. In winter and spring, since food productivity by trees is low, they appear to solve short food supply of those seasons using various tree species. Fecal sites were most frequently in winter, and then followed by autumn and spring, respectively.

Of total 16 species, the flying squirrels' fecal sites were most frequently found in *Quercus mongolica* (46.4%) and then followed by *Prunus sargentii* (25.6%) (Table 1). Throughout whole seasons, the trees of the genus *Quercus* are used most frequently as fecal sites and, of them, *Quercus mongolica* was preferred than the other species. In winter, *Prunus sargentii* was preferred more than *Quercus mongolica*, although trees of *Prunus sargentii* are less distributed compared with those of various trees of the genus

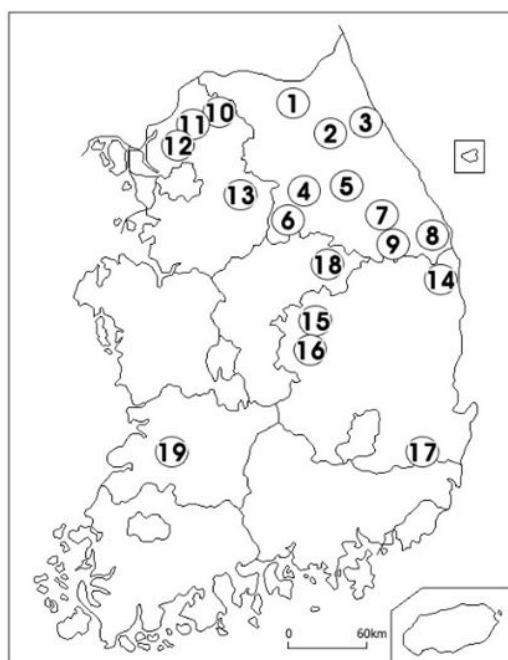


Fig. 1. Study areas. 1; Yanggu, 2; Inje 3; Yangyang, 4; Hoengseong, 5; Pyeongchang, 6; Wonju, 7; Jeongseon, 8; Samcheok, 9; Yeongwol, 10; Pocheon, 11; Dongducheon, 12; Yangju, 13; Yangpyeong, 14; Uljin, 15; Mungyeong, 16; Sangju, 17; Ulju, 18; Danyang, 19; Jeongeup.

Table 1. Frequency of fecal sites and tree species which the fecal sites were found along seasons

Tree species	No. fecal sites				No. of fecal sites	Frequency of fecal site (%)
	Spring	Summer	Autumn	Winter		
<i>Quercus mongolica</i>	14	5	20	19	58	46.4
<i>Quercus variabilis</i>	3	-	3	2	8	6.4
<i>Quercus dentata</i>	-	-	-	3	3	2.4
<i>Quercus aliena</i>	-	1	-	2	3	2.4
<i>Quercus serrata</i>	-	-	-	3	3	2.4
<i>Quercus acutissima</i>	-	-	1	2	3	2.4
<i>Castanea crenata</i>	-	-	-	1	1	0.8
<i>Prunus sargentii</i>	3	-	8	21	32	25.6
<i>Carpinus laxiflora</i>	-	-	-	1	1	0.8
<i>Betula davurica</i>	1	-	-	-	1	0.8
<i>Taxus cuspidata</i>	1	1	-	-	2	1.6
<i>Pinus densiflora</i>	1	-	-	1	2	1.6
<i>Robinia pseudoacacia</i>	1	-	-	-	1	0.8
<i>Ulmus davidianavar:japonica</i>	1	-	-	-	1	0.8
<i>Tilia amurensis</i>	2	-	-	3	5	4.0
<i>Acer</i> sp.	1	-	-	-	1	0.8
Proportion of the number of tree species	10	3	4	11	16	
The proportion of the total number of tree individuals	28	7	32	58	125	100.0
Frequency of tree species (%)	22.4	5.6	25.6	46.4	100	

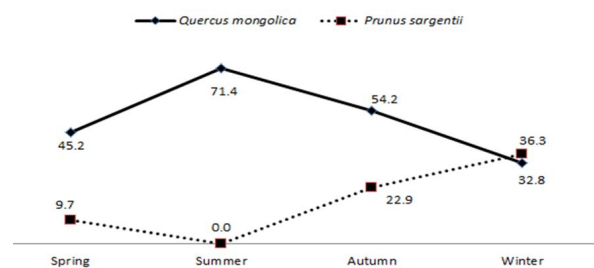


Fig. 2. Seasonal change in frequency of fecal sites in the two tree species of *Quercus mongolica* and *Prunus sargentii*.

Quercus. Thus, the flying squirrels have different preference along seasons (Fig. 2). In summer and autumn, high productivity of trees make the flying squirrels use only one or two species they prefer. In winter and spring, however, they should extend their food source to various tree species because of low productivity and less food sources.

The flying squirrels are dependent on broad leaf trees for their foods (Hanski 1998). In previous surveys, the flying squirrels the 6 species of broad leaf tree *Betula davurica*, *Cornus controversa*, *Prunus sargentii*, *Quercus ximccormickii*, *Quercus mongolica* and *Acer palmatum* were used

as fecal sites during the periods of March to Jun in Gangwon province (Cho et al. 2013). In Jiri National Park, the flying squirrels used broad leaf trees of *Cornus controversa*, *Alus japonica*, *Quercus serrata*, *Castanea crenata* and *Quercus variabilis* as their fecal sites, but fecal sites were not reported in coniferous trees (Woo et al. 2013). Thus, in survey for traces of the flying squirrels, the broad leaf trees should be focused in the forests.

Acknowledgements

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