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Change of Bird Communities at the Larch Plantation forests and Deciduous Forests in Jungwangsan, Korea

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Abstract

To coping with international convention and treaty relating with biological diversity, and to enhance the public awareness on the effect of forest practice on biodiversity and sustainable forest management in Korea, we evaluated the thinning effect on bird communities at Larch plantation forests (LF, 25.0% thinning at 9ha in size, a.s.l. 1,200m) and deciduous forests (DF, 55.3% thinning at 15.8ha in size, a.s.l. 600m) after two years from 2013 to 2015. Bird communities were surveyed by the combination of point counts (9 points) and line transect methods during breeding and non-breeding seasons with the sounds and observation by binocular and camera. We analyzed the composition of bird communities with nesting and foraging guild. After thinning practice in early spring of 2013, total 15 and 21 birds were recorded in 2013, forty and thirty-one species of birds in 2014, and sixty and forty species of birds in 2015 at the DF and LF, respectively. Data showed that one year took to recover the number of species after thinning at DF sites, and bush-nesting birds such as Winter Wren and Hazel Grouse were increased after thinning at LF sites. At a large forests area in Mt.Jungwangsan, forest practice like a 25.0% thinning at LF and 55.3% thinning at DF sites could not affect the bird community and increase the habitat diversity to attract the forests birds prefer bush and open space in forests areas. These results imply that spatial and temporal arrangement in a landscape approach could be fully considered to maintain and enhance biodiversity in forests.

Keywords: Bush-nesters, habitat heterogeneity, Shrub layer, Thinning

Introduction

South Korea has successfully implemented the national forest program and restored 64% of forest ecosystem. National forest program had been conducted from 1973 to 1987, and 77% of devastated areas were reduced, but 9% of forest area and 2.7-fold of forest volume were increased. Based on the restoration of forest resources, ecosystem services like biodiversity, water resources and forest recreation had been increased. Among diverse national forest programs, main program was the disciplines of planting trees and protecting lands in national forests. Government had a main program to plant fast-growing hardwoods, nitrogen-fixing trees and conifers by artificial planting. After 1980s, these artificially planted forests have experienced success process of semi-natural second forests (Korea Forest Services 2014). Larch Plantation Forests (LF, *Larix kaempferi*) was one of the most prominently planted tree species in disturbed areas during 1960s and 1970s in South Korea. Since 1960, total area planted with these trees has been approximately 7000 ㎢ (Korea Forest Research Institute 2009). Forest practices, especially tree thinning, have been very popular in larch plantations. However, there is little information about the influence of such tree thinning on birds in larch plantations, so we need to construct the effect of forest practice on the bird communities in larch plantation. Therefore, we hypothesized the two themes, 1) no significant difference after forest practice at LF, 2) no significant difference between deciduous forest (DF) and LF to assure the effect of forest practice in larch forests and compare the DF, which known as a normal type of secondary-processed forests in Korea.

Methodology/approach

Study sites

We selected two survey sites (LF-Larch Plantation Forests, DF-Deciduous Forests) at Jungwangsan in Pyeongchang City, South Korea. Each site was designed to has three different type of forest practice such as control (CT), 25% of thinning (25T) and 50% of thinning (50T) based on the tree density. Thinning had been applied in the year of 2012, and we surveyed the bird communities from 2013 (Fig. 1.).

Bird Survey Method

By using the digital contour maps (1:25,000 or 1:5000) and forest cover maps (1:5000), survey routes were chosen to include all habitats of birds. Birds were surveyed three times in each site with the line transect method in the morning from May 1 to July 5 in 2016. To avoid bias from repeated observations of the same individuals, we surveyed birds while walking at the speed of 2 km per hour between 0530 and 0800 on a clear day. Census trails were set up at the length enough to determine the number of species present in each site. All birds seen or heard within 25 m either side of the census trail were identified by song, call, flying type and field mark by eye or with binoculars (8x30). All birds seen were recorded and identified by binoculars, song and call, and the number of individuals were counted; the density was calculated as an individual density(ea/km/hr) of each species (Bibby et al. 2000, Parke and Lee 2000).

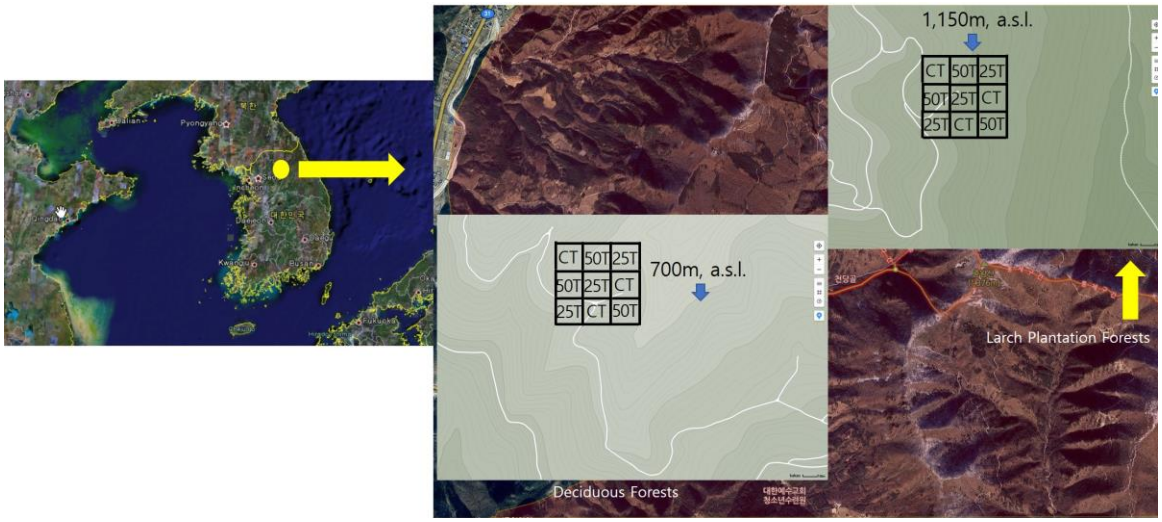

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Fig. 1: Locations of survey sites (LF-Larch Plantation Forests, DF-Deciduous Forests) at Jungwangsan in Pyeongchang City, South Korea

Guild and Statistical Analysis

We applied guild concepts to comprehend the nesting resources of breeding bird community, classified into nesting guild as hole, canopy, and bush (including ground), and functional guild were divided into canopy and bush based on the previous guideline (Lee and Park 1995) and the habit of forest birds (Lee et al. 2005).
For quantitative description of vertical structure of forest, foliage coverages were recorded at 5 m diameter plots at intervals of 50 m along the census trails in each area (Park and Lee 2000). The foliage height was classified into six layers (`A': above 17 m, `B': 13-17 m, `C': 9-13 m, `D': 5-9 m, `E': 1-5 m, and `F': <1 m). Four categories of foliage coverage were recorded in each height layer (0:0%, 1:1±33%, 2:34±66%, 3:67±100%).

Results

Change of number of species after thinning

Total fifteen and 21 birds were recorded in 2013, and forty and thirty-one species of birds in 2014, and sixty and forty species of birds in 2015 at the DF and LF, respectively. Legally protected species such as *Strix aluco*, *Strix uralensis*, *Accipiter gentilis* and *Drycopus martius* were not affected by thinning procedures. However, *Urosphens squameiceps* and *Turdus naumanni* were not observed, and *Dendrocopos major* was newly recorded at LF sites. In 2013 after thinning, LF showed the high number of species and significant difference of density of birds between DF and LF (Table 1). However, in 2015, DF showed the high number of species and density of birds between DF and LF (Table 2). Number of species and density were increased after thinning at DF sites, there were no significant increase after thinning at LF sites.

Change of guild composition after thinning

Thinning affected the change of guild composition at DF sites, but it did not affect the significant change of guild composition at LF sites (Table 1, 2). Canopy and bush nesters were increased at DF sites, but they did not change at LF sites after thinning.

Table 1. Breeding bird communities between deciduous forests and larch forests in 2013

Nesting guild	Number of species		Number of individuals		Foraging guild	Number of species		Number of individuals	
	DF	LF	DF	LF		DF	LF	DF	LF
Hole	5(33.3)	5(23.8)	17(31.5)	8(14.0)	Canopy	6(40.0)	8(38.1)	20(37.0)	17(29.8)
Canopy	3(20.0)	6(28.6)	15(27.8)	22(38.6)	Bush	5(33.3)	10(47.6)	24(44.4)	35(61.4)
Bush	3(20.0)	7(33.3)	12(22.2)	22(38.6)	*	4(26.7)	3(14.3)	10(18.5)	5(8.8)
*	4(26.7)	3(14.3)	10(18.5)	5(8.8)					
Total	15	21	54	57		15	21	54	57
P-value	P=0.25		P<0.0001			P=0.34		P<0.05	

DF: Deciduous forests, LF: Larch forests

Table 2. Breeding bird communities between deciduous forests and larch forests in 2015

Nesting guild	Number of species		Number of individuals		Foraging guild	Number of species		Number of individuals	
	DF	LF	DF	LF		DF	LF	DF	LF
Hole	9	6	29.0±5.7	13.0±3.1	Canopy	15	8	41.0±12.4	22.3±5.0
Canopy	8	6	24.3±11.0	22.3±2.2	Bush	10	11	31.3±2.9	34.6±0.4
Bush	8	7	19.0±5.3	21.6±0.4					
Total	25	19	72.3	56.9		25	19	72.3	56.9
P-value	P<0.0001		P<0.0001			P<0.001		P<0.05	

DF: Deciduous forests, LF: Larch forests

Coverage Changes after thinning

Thinning practice did significantly change mean values of coverages from 1 to 9 meter at DF sites and mean values below 5 meters at LF sites. Two sites showed the increase of mean coverage values below 1 meter, and they showed the significant decrease of coverage value from 1 to 5 meter after thinning (Table 3).

Table 3: Mean change of coverage between DF and LF after thinning

Foliage layer	Cover Change (DF) Mean±S.E.	Cover Change (LF) Mean±S.E.
A (over 17m)	-1.5±0.3	-1.0±0.4
B (13-17m)	-1.2±0.3	-1.0±0.3
C (9-13m)	-2.0±0.6	-1.8±0.2
D (5-9m)	-3.0±0.2**	-2.1±0.2
E (1-5m)	-2.5±0.5**	-2.3±0.5**
F (below 1m)	1.2±0.2	1.8±0.3**

Discussion

Experimented thinning practice did not change the bird communities in Larch plantation forests, however it did increase the number of species and density, and it changed the guild composition in deciduous forests. Also, after thinning, forest vertical structures increased the coverage value of layer below 1 m at study sites, it might affect the bush and ground-habitat preferred birds such as Hazel grouse and Winter wren at Larch forests. One year later after thinning, two sites did not significantly show the difference of number of birds. However, we could determine the significant difference of number of species and density after three years. Also, the stand-level difference by thinning were identified and it could be attributed to the difference of shrub layer between two areas (Table 3). Usually, coniferous forests do not possess the high value of biodiversity, but this mosaic treatment of Larch forests can give us an insight to manage and maintain the high value of biodiversity in a sustainable way.

Conclusions/ wider implications of findings

These results imply that spatial and temporal arrangement in a landscape approach could be fully considered to maintain and enhance biodiversity in forests.

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