J. Ecol. Field Biol. 29 (2): 75~84, 2006

# Bibosoop: A Unique Korean Biotope for Cavity Nesting Birds

Park, Chan-Ryul*, Joon Hwan Shin[1] and Dowon Lee[2]
*Division of Forest Ecology, Korea Forest Research Institute, Seoul 130-712, Korea*
[1]*Department of Forest Environment, Korea Forest Research Institute, Seoul 130-712, Korea*
[2]*Graduate School of Environmental Studies, Seoul National University, Seoul 151-742, Korea*

**ABSTRACT**: In Korea, a bibosoop is a type of village grove fostered to complement a weak part of the village from a Feng-Shui perspective. We examined the characteristics of bird communities in remaining bibosoops in two regions, Gyeonggi-do Province and Jeollanam-do Province. We surveyed patch preferences of birds at two landscapes in Gyeonggi-do Province. One contains a bibosoop with other rural landscape elements, and the other does not have a bibosoop. The two landscapes of Gyeonggi-do Province were similar to each other in the distribution of landscape elements. We observed that species richness was significantly higher at the site with a bibosoop, and that tits, Mandarian ducks, starlings, Eurasian scoops owls, and woodpeckers utilized the bibosoop as a nesting site. Birds preferred the landscape with the bibosoop, and the internal movement of birds was significantly higher at the landscape with the bibosoop than at the other. The results suggest that bibosoops serve as a unique biotope that provides nest sites for cavity nesters, especially near nest-insufficient forests, and enhance the internal movements of birds among patches in the landscape.

***Key words***: Bird community, Cavity nesters, Nesting guilds, Patch use, Rural landscapes

## INTRODUCTION

Biodiversity is highly retained in traditional cultivation systems that humans and nature have organized since the times of ancient agricultural societies (Balmford et al. 2001, Hughes et al. 2002, Luetz and Bastian 2002), while urban sprawl into rural landscapes has accelerated the fragmentation of forests and diminished the habitat quality for wildlife (Radeloff et al. 2005). Hedgerows are a feature of the English countryside, creating the characteristic pattern and structure of the landscape (Wegner and Merriam 1979, Formann and Baudry 1984, Fahrig and Merriam 1985, Dmowski and Kozakiewicz 1990, Estrada et al. 2000, Fukamachi et al. 2003), and satoyama landscapes are managed, compact mosaics of cultivation, open woodland, coppice-woods and forests which surround villages and hamlets in Japan (Fukamachi et al. 2001). The ecological importance of hedgerows and satoyama for maintaining biodiversity has been well addressed by researchers (Wegner and Merriam 1979, Fukamachi et al. 2001, 2003).

On the Korean peninsula, traditional human and non-human elements of the landscape had been harmonized in terms of Feng-Shui for the well-being of human life. The bibosoop was a major component of these traditional Korean village landscapes of paddy fields, dry fields, and backyard forests (Fig. 1). For example, a forested strip was fostered at the mouth of a watershed, within which a village, called a maeul in Korean, was positioned. The reason was because they were vulnerable when the village was largely exposed to the external world. Thus the bibosoop is a unique feature of Korean landscapes that has some practical functions, and is rarely found in other countries (Lee and Park 2004).

As the Korean peninsula belongs to the monsoon climate region, cold, dry, harsh winds come from the northwest in winter and warm, humid winds, called typhoons, come from Southeast Asia in summer. The Korean landscape is characterized by its mountainous ridge system, the Baekdudaegan (a word based on the traditional concept of a predominant mountain range), that runs from Mt. Baekdusan (a.s.l. 2,744 m) to Mt. Jirisan (a.s.l. 1,950 m) and forms the backbone of the peninsula's topography. Koreans considered the Baekdudaegan to be as a tree trunk, and the many small ranges as branches diverging from the Baekdudaegan; a village was located at the leaf of the tree. As a matter of fact, a leaf indicates a small watershed. Under this climate and topography, Koreans have experienced severe losses of soil and nutrients from the land to the sea over a long period of time (Lee and Shin 2003). Hence, the Korean people have developed many types of practices to keep soils and nutrients in villages and agricultural areas that are surrounded by mountains. Traditionally, planting trees was one of the major management practices to control erosion and nutrient losses from the land. It was one of the practical reasons why a small grove was fostered at the mouth of a watershed, and sometimes at other lo-

* Corresponding author; Phone: +82-2-961-2613, e-mail: chandrap@chol.com, park@foa.go.kr

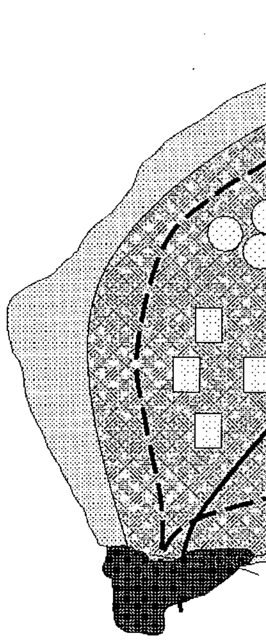

Fig. 1. Maeul ("village" in Korean) landscape of Boryong-ri, Yangpyeong-gun, Gyeonggi-do, including surrounding forest (light black dotted area), bibosoop (black area), streams (dashed lines), road (solid line), houses (circles), dry fields (triangles) and paddy fields (rectangles).

cations. This small village grove is called maeulsoop or bibosoop, and looks like a shelterbelt, riparian vegetation buffer, and/or hedgerow depending on its position in the watershed. One hundred years ago many bibosoops were scattered throughout the country, but over the past several decades many have been reduced in size and destroyed, especially in developed areas (Lee and Park 2004).

Recently, it was suggested that bibosoops serve many other functions beneficial to humans. Such functions include supplying moisture and oxygen to the air of villages through evapotranspiration and photosynthesis, adding organic matter to crop areas, and enhancing the biodiversity of the landscape. Until now, however, little attention has been paid to a role that bibosoops play in enhancing the biodiversity of landscapes. The objective of the present study is to examine the characteristics of bird communities in bibosoops, and the effects of bibosoops on use of patches by birds in traditional rural landscapes.

## STUDY SITES AND METHODS

### Study Sites

We selected seven bibosoops (Sanggok-ri N 35° 09′ 34.0″ E 126° 35′ 31.9″, Hyanggyo-ri N 35° 04′ 03.0″ E 126° 31′ 54.2″, Anyoung N 35° 07′ 11.6″ E 126° 35′ 37.7″, Gamsan N 35° 06′ 59.4″ E 126° 29′ 57.5″, Yeonha-Ri N 35° 30′ 45.8″ E 126° 33′ 50.3″, Beopsungpo N 35° 06′ 36.5″ E 126° 25′ 33.5″, and Nae-ri N 34° 87′ 00.3″ E 127° 03′ 97.5″) in the Jeollanam-do Province to investigate the species composition of bird communities at bibosoops. To study the effects of bibosoops on bird communities, we selected two villages (one with a bibosoop, the other without a bibosoop) at Boryong-ri (N 37° 32′ 16.5″, E 127° 40′ 20.6″) in Gyeonggi-do Province (Fig. 2). The selected bibosoops had been constructed and planted by family predecessors of local villagers no less than three hundred years ago. We recorded the height and diameter at breast height (dbh, using a measuring tape) of trees of > 6 cm dbh, and calculated the frequency of each tree species at the seven bibosoops. *Zelkova serrata* was observed at all the bibosoops in Jeollanam-do Province and Gyeonggi-do Province, and *Celtis sinensis* appeared in all the Jeollanam-do Province bibosoops. The number of tree species was high at the Boryong-ri bibosoop, and tree density was high at the Anyong bibosoop (Appendix 1).

### Bird Observations

We employed two methods to identify breeding of birds: point count method and line transect method. A point count method was applied to survey the breeding birds at the seven bibosoops in Jeollanam-do on 10th, 11th, 12th May and 14th, 15th, 16th July

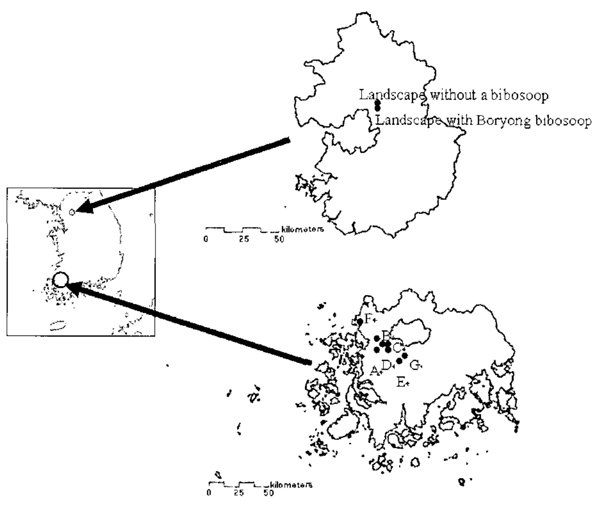


Fig. 2. Locations of the study areas: southern seven bibosoops (A; Sanggok-ri, B; Hyanggo-ri, C; Anyoung, D; Gamsan, E; Yeonha-ri, F; Beopsungpo, G; Nae-ri) located in Jeollanam-do Province used to study the characteristics of bird communities in the bibosoops; dotted northern two landscapes, with (Boryong-ri bibosoop) and without bibosoops, located in the Gyeonggi-do Province, used to study the effect of bibosoop on bird communities and to compare patch use between the two landscapes.

2003. Birds were identified using binoculars (8 × 30), songs and calls, and the number of individuals was counted and recorded (Bibby et al. 1997). We visited each survey area once or twice, and recorded birds within bibosoops by 15 min.-point census methods. During the period of survey, the minimum number of individuals of breeding birds was used as the breeding individuals count for a study area. We only recorded birds staying in the bibosoop, and excluded those passing over the bibosoop or just in nearby paddy fields.

Meanwhile, we investigated breeding bird communities in the landscapes with and without bibosoop by the line transect method. To avoid bias from repeated observations of the same individuals, we surveyed birds while walking 2 km during one hour between 07:00 and 12:00 on clear days. All birds were identified using binoculars (8 × 30), songs and calls during three consecutive days in June, July and August, 2003. And, we recorded the movements of observed birds from 07:00 to 08:00 during five consecutive, clear days. We considered the difference between movement in the morning and the evening, but used only data of patch movement in the morning, in order to diminish the variation of the data. We designated the starting and arriving patches as follows: bibosoops (Bibo), oaks forests (Oak), paddy fields (Pad), dry fields (Dfd), *Pinus koraiensis* forests (Pkf), *Larix kaempferi* forests (Lkf), electric poles (Ep), tributaries (Trib), houses (Ho), and outside the landscapes (Out). In addition, we recorded the movement of birds toward the outside region of each landscape.

### Landscape Measurements

We mapped the distribution of patches based on 1:5,000 digital maps of the landscapes with and without bibosoop. Distribution of patches was digitized and analyzed with ArcView version 3.2 (ESRI). In digitizing patches, we showed the patches as follows: bibosoops (Bibo), oaks forests (Oak), paddy fields (Pad), dry fields (Dfd), *Pinus koraiensis* forests (Pkf), *Larix kaempferi* forests (Lkf) and bush field (Bush). We excluded elements of roads, houses, and tributaries, due to their considerably small areas in each landscape (Fig. 3, 4).

### Data Analysis

Guild analysis was conducted to comprehend the composition of bird communities at the seven bibosoops. Guilds were characterized by nesting site as: primary cavity nester (PCN, birds can make a cavity by themselves), secondary cavity nester (SCN, birds cannot make a cavity by themselves and utilize a cavity made by PCN as a nest), bush & ground nester (B), canopy nester (C), house nester (H), and migrating birds (MIG) according to the modification of criteria by Lee and Park (1995). Density data of each guild was

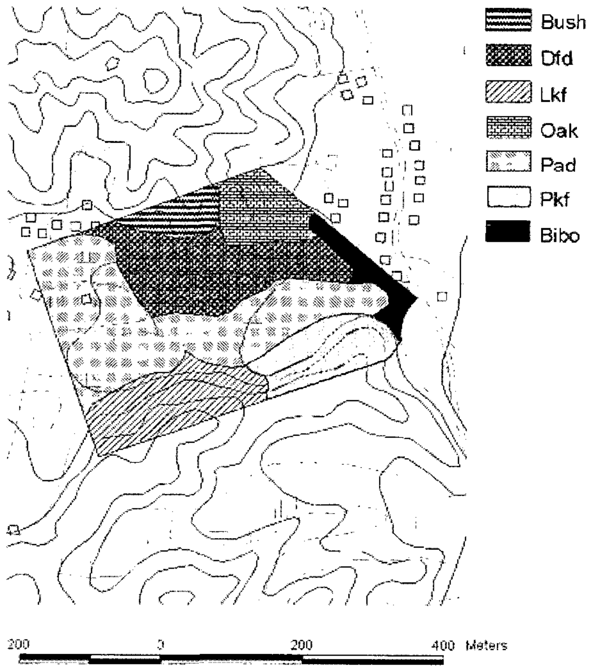


Fig. 3. Distribution of patches within the landscape with bibosoop (Bush; bush field, Dfd; dryfield, Lkf; *Larix kaempferi* forests, Oak: oaks forests, Pad; paddy fields, Pkf; *Pinus koraiensis* forests, Bibo; Bibosoops).

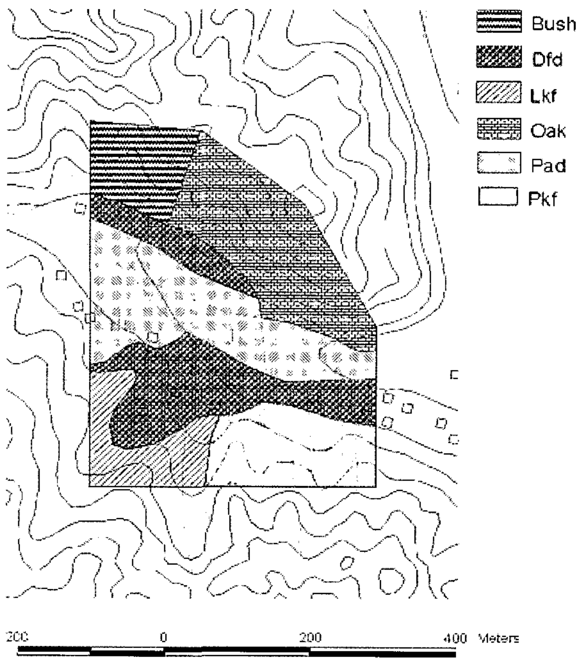


Fig. 4. Distribution of patches across the landscape without bibosoop (Bush; bush field, Dfd; dryfield, Lkf; *Larix kaempferi* forests, Oak: oaks forests, Pad; paddy fields, Pkf; *Pinus koraiensis* forests, Bibo; Bibosoops).

used for non-metric multidimensional scaling performed on PAST version 1.32 (Hammer et al. 2001), which was used to describe the similarity of bird communities among the seven areas. In the two landscapes, patch preference of birds was calculated with ln ($r_i$/$p_i$), where $r_i$ was the proportion used by birds and $p_i$ was the proportion of patch *i* in each landscape, according to the modification of the Ivlev electivity index (Jacobs 1974). T-test was applied to test the difference of number of individuals or species richness of birds between with- and without-biboop landscapes. Fisher's exact test was used to test the difference of internal and external movements between two landscapes.

## RESULTS

### Characteristics of Bird Communities in Bibosoops

Table 1 shows the observed individual birds at each bibosoop in the Jeollanam-do Province. Thirty species of birds were observed; they were composed of four species of primary cavity nesters (PCN), seven species of secondary cavity nesters (SCN), eight species of bush & ground nesters (B), six species of canopy nesters (C), two species of house nesters (H), and three species of migrants (MIG). *Otus scops*, *Dendrocopos kizuki*, *Hirundo rustica*, *Parus major*, *Sturnus cineraceus* and *Passer montanus* were present at all bibosoops, and *Picus canus* was observed at six bibosoops. *Caprimulgus indicus*, *Dendrocopos leucotos*, *Streptopelia orientalis*, *Lanius bucephalus*, *Cettia diphone*, *Emberiza cioides*, *Carduelis spinus*, *Coccothraustes cocothraustes*, and *Cyanopica cyana* were observed at only one bibosoop. The total average observed frequency of PCN was 0.64, SCN 0.78, bush and ground nesters 0.25, canopy nesters 0.24, and migrants 0.24 (Table 1). So, birds belonging to PCN and SCN more frequently utilized the bibosoop than other guilds of birds. Among the seven bibosoops, the Gamsan bibosoops had the highest number of birds, and Sanggok-ri, Hyanggyo-ri and Nae-ri had a relatively low number of species. The composition of the nesting guilds of birds at seven bibosoops was more related with that of the hole-nesting guild (Fig. 5).

### Comparison of Breeding Bird Communities between Landscapes with and without Bibosoops

Twenty-six species of birds were observed at the two landscapes; among them were seven species of cavity nesters, 13 species of canopy nesters, two species of bush and ground nesters, and two species of house nesters. The numbers of species were higher for the landscape with a bibosoop ($t$=5.96, df=6, $p$<0.001). Among the observed birds, *Aix galericulata, Otus scops, Caprimulgus indicus, Upupa epops, Halcyon pileata, Dendrocopos leucotos*, and *Aegithalos caudatus* were observed only in landscapes with a bibosoop. We found nests of *Aix galericulata, Accipiter soloensis, Otus scops, Upupa epops*, and *Eurystomus orientalis* at the Boryong bibosoop. *Egretta intermedia, Bubulcus ibis, Cuculus canorus, Hirundo rustica, Cyanopica cyana* and *Corvus corone* had a higher mean value of observed individuals in the landscape with no bibosoop than in landscapes with a bibosoop (Table 2).

### Bird Patch Uses and Preferences between Landscapes with and without Bibosoops

Paddy fields were the dominant patch type in both landscapes (Fig. 3, 4, Table 3), and there was no significant difference in patterns of land use ($\chi^2$=12.7, df=5, $p$=0.13). In the landscape with a bibosoop, paddy fields, dry fields and *Larix kaempferi* forests were dominant, and in those with no bibosoop, paddy fields, oak forests and dry fields dominated. Bird patch use was highest in paddy fields, *Pinus koraiensis* forests, and then *Larix kaempferi* forests in the landscape with a bibosoop, and patch use was highest in paddy fields, oak forests and *Larix kaempferi* forests in the landscape without a bibosoop. However, birds highly preferred the bibosoop and oaks forests in the landscape with a bibosoop, and they selectively preferred *Larix kaempferi* forests in the landscape with no bibosoop. Birds frequently utilized internal patches of the landscape with a bibosoop, but moved towards external areas of the landscape with no bibosoop (Fisher's exact test $p$<0.05, Table 3).

## DISCUSSIONS

Guild compositions of bird communities at bibosoops showed a higher number of cavity nesting species of PCN and SCN (11 species total and frequencies over 0.5), although bibosoops are located near streams and villages far from large natural forest areas

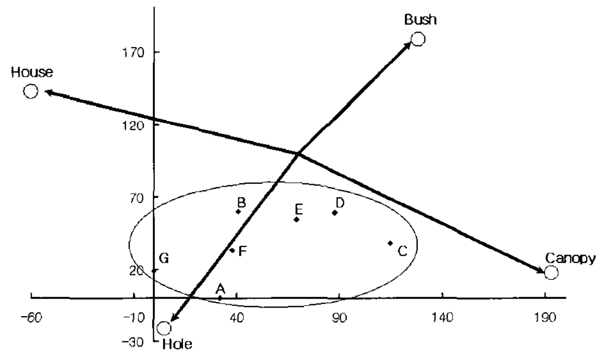


Fig. 5. The similarity of guild compositions as described by non-metric multidimensional-scaling (using PAST 1.32) among seven areas (See Table 1 for each area). The locations of hole, canopy, bush and house indicate the relative location of each guild.

Table 1. Observed individuals of birds at each bibosoop in Jeollanam-do Province

| Scientific name | N[a] | A[b] | B | C | D | E | F | G | Freq.[c] |
|---|---|---|---|---|---|---|---|---|---|
| | Area ($m^2$) | 1,000 | 18,274 | 1,000 | 2,400 | 4,000 | 18,000 | 5,000 | |
| *Aix galericulata* | SCN | | | 1 | 1 | 1 | | 1 | 0.57 |
| *Otus scops* | SCN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| *Caprimulgus indicus* | B | | 1 | | | | | | 0.14 |
| *Phasianus colchicus* | B | | | | 2 | | 2 | | 0.29 |
| *Dendrocopos leucotos* | PCN | | | | | 2 | | | 0.14 |
| *Dendrocopos major* | PCN | | | 1 | 2 | 2 | 1 | | 0.57 |
| *Picus canus* | PCN | 1 | | 1 | 2 | 2 | 1 | 1 | 0.86 |
| *Dendrocopos kizuki* | PCN | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 1.00 |
| *Streptopelia orientalis* | B | | | | | 2 | | | 0.14 |
| *Hypsipetes amaurotis* | C | 2 | | | | | 4 | | 0.29 |
| *Hirundo rustica* | H | 2 | 2 | 3 | 4 | 3 | 4 | 3 | 1.00 |
| *Paradoxornis webbiana* | B | | 5 | 5 | 15 | 12 | 6 | | 0.71 |
| *Turdus dauma* | C | | 2 | | | | | | 0.14 |
| *Lanius bucephalus* | B | | | 2 | | | | | 0.14 |
| *Phoenicuros auroreus* | H | | 2 | | | | | 2 | 0.29 |
| *Cettia diphone* | B | | | | 2 | | | | 0.14 |
| *Parus major* | SCN | 2 | 1 | 2 | 4 | 2 | 3 | 2 | 1.00 |
| *Parus varius* | SCN | | | | 6 | 3 | 4 | 3 | 0.57 |
| *Parus ater* | SCN | | | | | 2 | 8 | | 0.29 |
| *Aegithalos caudatus* | C | 2 | | | 5 | | | | 0.29 |
| *Emberiza elegans* | B | | | 2 | 2 | | | | 0.29 |
| *Emberiza cioides* | B | | | 2 | | | | | 0.14 |
| *Carduelis spinus* | MIG | | | | 12 | | | | 0.14 |
| *Cocothraustes cocothraustes* | MIG | | | | | | 5 | | 0.14 |
| *Fringilla montifringilla* | MIG | 34 | 2 | | | | 12 | | 0.43 |
| *Sturnus cineraceus* | SCN | 10 | 5 | 8 | 5 | 4 | 4 | 2 | 1.00 |
| *Passer montanus* | SCN | 2 | 3 | 4 | 3 | 2 | 5 | 2 | 1.00 |
| *Oriolus chinensis* | C | | | 1 | 1 | 1 | | 1 | 0.57 |
| *Cyanopica cyana* | C | | | 22 | | | | | 0.14 |
| *Pica pica* | C | | | 10 | 12 | 7 | | | 0.43 |
| Number of species | | 10 | 11 | 16 | 18 | 16 | 15 | 11 | |
| Number of individuals | | 58 | 26 | 67 | 81 | 48 | 62 | 22 | |

[a] N: Nesting guild - PCN: primary cavity nester, SCN: secondary cavity nester, C: canopy nester, B: bush & ground nester, H: house nester, MIG: migrants.

[b] A: Sanggok-ri, B: Hyanggyo-ri, C: Anyoung, D: Gamsan, E: Yeonha-ri, F: Beopsungpo, G: Nae-ri.

[c] Freq.: Observed frequencies at seven bibosoops.

Table 2. Observed individuals of birds during four days at two study areas in Yangpyeong-gun

| Scientific name | N[a] | With bibosoop | | With no bibosoop | |
|---|---|---|---|---|---|
| | | Mean + SD | Freq. | Mean + SD | Freq. |
| *Dendrocopos leucotos* | PCN | 3.0 + 1.0 | 0.75 | | |
| *Aix galericulata* | SCN | 2.3 + 1.0 | 1.00 | | |
| *Otus scops* | SCN | 1.0 + 0 | 1.00 | | |
| *Upupa epops* | SCN | 1.0 + 0 | 1.00 | | |
| *Parus major* | SCN | 3.0 + 0.8 | 1.00 | 2.5 + 1.3 | 1.00 |
| *Parus varius* | SCN | 3.5 + 0.6 | 1.00 | 3.0 + 0.8 | 1.00 |
| *Passer montanus* | SCN | 10.8 + 2.5 | 1.00 | 8.3 + 1.0 | 1.00 |
| *Hirundo rustica* | H | 4.3 + 1.7 | 1.00 | 5.3 + 2.2 | 1.00 |
| *Phoenicurus auroreus* | H | 1.5 + 0.6 | 1.00 | 1.5 + 0.6 | 1.00 |
| *Accipiter soloensis* | C | 4.3 + 1.5 | 1.00 | 2.0 + 0 | 0.75 |
| *Egretta intermedia* | C | 2.0 + 0.8 | 1.00 | 4.8 + 1.0 | 1.00 |
| *Egretta garzetta* | C | 4.5 + 1.3 | 1.00 | 3.3 + 1.0 | 1.00 |
| *Bubulcus ibis* | C | 1.5 + 0.6 | 1.00 | 3.0 + 0.8 | 1.00 |
| *Butorides striatus* | C | 1.5 + 0.6 | 1.00 | 1.0 + 0 | 0.75 |
| *Eurystomus orientalis* | C | 5.8 + 1.0 | 1.00 | 5.0 + 0.8 | 1.00 |
| *Hypsipetes amaurotis* | C | 4.0 + 1.4 | 1.00 | 3.5 + 1.9 | 1.00 |
| *Aegithalos caudatus* | C | 0.8 + 0 | 0.25 | | |
| *Oriolus chinensis* | C | 2.5 + 1.0 | 1.00 | 1.8 + 0.5 | 1.00 |
| *Garrulus glandarius* | C | 3.0 + 0.8 | 1.00 | 3.0 + 0.8 | 1.00 |
| *Cyanopica cyana* | C | | | 7.0 + 1.4 | 0.50 |
| *Pica pica* | C | 7.3 + 2.2 | 1.00 | 5.5 + 1.3 | 1.00 |
| *Corvus corone* | C | 2.3 + 0.5 | 1.00 | 2.8 + 1.0 | 1.00 |
| *Caprimulgus indicus* | B | 1.0 + 0 | 1.00 | | |
| *Streptopelia orientalis* | B | 3.5 + 1.9 | 1.00 | 3.5 + 1.3 | 1.00 |
| *Cuculus canorus* | *[b] | 1.3 + 0.5 | 1.00 | 1.5 + 0.6 | 1.00 |
| *Halcyon pileata* | * | 2.0 + 0 | 0.75 | | |
| Number of species | | 23.0 + 1.0 | | 19.0 + 0.8 | |
| | | *t*-test: 5.96, df=6, $p$<0.001 | | | |
| Number of individuals | | 76.0 + 18.6 | | 63.8 + 13.5 | |
| | | *t*-test: not significant | | | |

[a] N: Nesting guild - PCN: primary cavity nester, SCN: secondary cavity nester, C: canopy nester, B: bush & ground nester, H: house nester.
[b] These birds were omitted for guild characterization due to peculiarity of breeding habit.

Table 3. Patch use & preference, and movements of birds within the two landscapes

| Patches and movements | | Wth bibosoop | | Wth no bibosoop | |
|---|---|---|---|---|---|
| | | Area ($m^2$)[a] | Bird use (%)[b] | Area ($m^2$) | Bird use (%) |
| Patches | Bush | 6,897.2 ( 4.9) | 0 (−0.14) | 15,643.7 ( 9.1) | 0 (−0.08) |
| | Dry field | 29,113.7 (20.6) | 6.7 ( 0.10) | 39,655.7 (22.2) | 16.1 ( 0.13) |
| | *Larix kaempferi forest* | 20,451.1 (14.5) | 21.1 ( 0.21) | 16,024.6 ( 9.2) | 12.5 ( 0.28) |
| | Oak forests | 11,581.4 ( 8.2) | 26.7 ( 0.40) | 38,870.8 (22.3) | 23.2 ( 0.14) |
| | Paddy field | 51,895.7 (36.8) | 23.3 ( 0.09) | 40,777.9 (23.4) | 39.3 ( 0.16) |
| | *Pinus koraiensis forest* | 14,926.5 (10.6) | 4.4 ( 0.15) | 24,050.5 (13.8) | 8.9 ( 0.16) |
| | Bibosoop | 6,271.8 ( 4.4) | 17.8 ( 0.66) | 0 ( 0) | 0 ( 0.00) |
| Movements | Internal movements[c] | | 86.2 | | 70.0 |
| | External movements[d] | | 13.8 | | 30.0 |
| | Fisher's exact test[e] | | $P<0.05$ (with bibosoop $n=90$, with no bibosoop, $n=56$) | | |
| Diversity indices of patch use | | | 1.64 | | 1.47 |

[a] Values in parenthesis show the percentage of each item.
[b] Values in parenthesis show the preference index of each item.
[c] Movements of birds among patches at study area.
[d] Movements of birds from study area to outer area.
[e] Fisher's exact test was done for comparison of internal and external movement between two landscapes.

(Table 1, Fig. 5). The highest number of cavity nesting species was in large, natural forests (Kim et al. 1996), and canopy nesters are known to dominate bird communities in urban (Park and Lee 2000) and rural areas (Park and Lee 2002). This pattern may be related to old, large dbh trees at bibosoops, which are suitable for cavity nesters to nest in. Breeding bird communities had a high number of canopy nesters in the rural landscape with no bibosoop (Table 2, Park and Lee 2002). However, breeding birds of cavity nesters were higher for the landscape with a bibosoop. Especially, and even in cavity nesters, larger bird species like *Dendrocopos leucotos*, *Aix galericulata, Otus scops* and *Upupa epops* were only in the landscape with a bibosoop while small bird species like *Parus major*, *Parus varius* and *Passer montanus* appeared in both landscapes. It is reasonable that house nesters appeared in both landscapes because there are houses in the two landscapes. Also, the landscape with a bibosoop showed a higher number of species than landscape without a bibosoop (Table 2).

Birds in the landscape with a bibosoop preferred oak patches, not to speak of bibosoop, and birds in the landscape without a bibosoop preferred paddy fields even though they are smaller than the other types of patches. Also, the internal movement of birds within the landscape with a bibosoop was higher than that of birds in the landscape with no bibosoop (Table 3). Birds can utilize the bibosoop for a nest site, and can search food resources such as insect larvae in the oak forest. These results could be related to the high correlations of bird communities with the habitat heterogeneity of agricultural landscapes (Jeanneret et al. 2003, Atauri and Lucio 2001). Birds may mediate cross-habitat flow of materials among patches in landscapes with bibosoops. Oak forests dominated by *Q. acutissima* are found in villages in rural landscapes. Korean people have traditionally utilized the acorns of oak trees as food by first removing the tannins. Nowadays, Koreans usually enjoy acorn jelly, called dotorimuk, as ordinal dishes at the shop and market. This traditional use of acorn jelly is well connected with the conservation of oak forests. One species of waterfowl, *Aix galericulata*, feeds largely on aquatic vertebrates in spring and summer and on acorns in autumn and winter (Won 1981). So this bird may prefer the traditional rural landscapes with bibosoops and oak forests. Also, *Accipiter soloensis* prefers to nest near rivers, paddy fields and forests, and they utilize frogs and cicadas as food resources that can be found in rural landscapes in Korea. Bibosoops can similarly serve as a unique biotope for other cavity nesters such as *Aix galericulata, Otus scops, Dendrocopos kizuki, Parus major, Sturnus cineraceus, Picus canus*, and *Passer montanus*. In landscapes with flat and smooth topography, hedgerows and shrub corridors are known to serve as the main habitat of bush and ground nesting birds (Wegner and Merriam 1979, Formann and Baudry 1984, Fahrig and Merriam 1985, Dmowski and Kozakiewicz 1990, Estrada et al. 2000). However, in rugged, rough Korean landscapes, the village groves can serve as a biotope for primary and secondary cavity nesting birds. Although there are some traditional hedgerows of the shrub tree *Poncirus trifoliate* fenced around houses in traditional villages, the general configuration was to have a village grove located in front of the village, and forests on both sides and in back of the village (Chosun Governor General 1938, Kim and Jang 1994, Korea Forest Research Institute 1995). In these communities, villagers or a family possessed the land and tried to preserve the forest as a sacred and recreational place. From an ecological viewpoint, rural landscapes organized with bibosoops, paddy fields, rivers, villages and oak forests could be a unique biotope for birds in the Korean landscape. From a cultural viewpoint, Koreans have formed unique cultural and historical monuments, including big trees in bibosoops, through their struggle with the rugged topography and severe monsoon climate. Therefore, systematic and precise research on the interaction network among people, bibosoops, and nature should be addressed in the near future.

Recent developments in road building and urbanization have led to the destruction of this biotope and also threaten the traditional culture of the local area. In the 1970s, rural development known as the Saemaeul campaign (a movement for the establishment of new, modernized villages conducted by the government) presented many bibosoops and maeul with unfavorable circumstances. In addition, the migration of people from rural to urban areas accelerated the deterioration of the maeul and the degradation of the bibosoops due to changes in the social labor system. In this process, bibosoops have been reduced and may be endangered in the near future, notwithstanding their important roles for maintaining biodiversity and cultural self-confidence in Korea.

These results indicate that bibosoops can provide nest sites for cavity nesters, especially near nest-insufficient forests, and indirectly enhance the internal movements of birds among patches. Some bibosoops have recently been well preserved by villagers or families, however most of bibosoops have been destroyed and degraded by rural development and changes in the social labor system. Worldwide, modernized planning techniques have been applied in urban and rural areas for green networking and recreational demands. However, landscape planners should be adaptive within their discipline and should consider traditional knowledge which has been handed down and that is inherent to the land and culture of their own country and village.

## ACKNOWLEDGEMENTS

D. Lee's work on this paper was supported by a grant (No. 03-03-211-39) from the Institute of Korean Studies, Seoul National University, Republic of Korea.

## LITERATURE CITED

Atauri JA, DeLucio JV. 2001. The role of landscape structure in species richness distribution of birds, amphibians, reptiles and lepidopterans in Mediterranean landscapes. Landsc Ecol 16: 147-159.

Balmford A, Moore JL, Brooks T, Burgess N, Hansen LA, Williams P, Rahbek C. 2001. Conservation conflicts across Africa. Science 291: 2616-2619.

Bibby CJ, Burgess ND, Hill DA. 1997. Bird census technique. Academic press limited, London.

Chosun Governor General. 1938. Imsoos in Chosun. Chosun Governer General, Seoul (in Japanese).

Dmowski K, Kozakiewicz M. 1990. Influence of a shrub corridor on movements of passerine birds to a lake littoral zone. Landsc Ecol 4(2/3): 99-108.

Estrada A, Cammarano P, Coates-Estrada R. 2000. Bird species richness in vegetation fences and in strips of residual rain forest vegetation at Los Tuxtlas, Mexico. Biodivers Conserv 9: 1399-1416.

Fahrig L, Merriam HG. 1985. Habitat patch connectivity and population survival. Ecology 67: 1762-1768.

Forman RTT, Baudry J. 1984. Hedgerows and hedgerow networks in landscape ecology. Environ Manag 8: 499-510.

Fukamachi K, Oku H, Nakashizuka T. 2001. The change of a Satoyama landscape and its causality in Kamiseya, Kyoto Prefecture, Japan between 1970 and 1995. Landsc Ecol 16: 703-717.

Fukamachi K, Oku H, Oliver R. 2003. A comparative study on trees and hedgerows in Japan and England, in: Palang H, Fry G. (Eds.), Landscape interfaces -Cultural heritage in changing landscapes. Kluwer Academic Publishers, London, pp 53-70.

Hammer Ø, Harper DAT, Ryan PD. 2001. PAST: Paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4: issue 1:http://palaeo-electronica.org/2001_1/past/issue1_01.htm.

Hughes JB, Daily G, Ehrlich PR. 2002. Conservation of tropical forest birds in countryside habitats. Ecol Lett 5: 121-129.

Jacobs J. 1974. Quantitative measurement of food selection: a modification of the forage ratio and Ivlev's selectivity index. Oecologia 14: 413-417.

Jeanneret P, Schupbach B, Luka H. 2003. Qunatifying the impact of landscape and habitat features on biodiversity in cultivated landscapes. Agric Ecosyst Environ 98: 311-320.

Kim HB, Jang DS. 1994. Maulsoop, the Korean village grove. Youl

Hwa Dang Publisher, Seoul (in Korean with English abstract).

Kim SW, Lee WS, Park CR, Cho KH. 1996. Bird Diversity, in: Forest Research Institute (Ed.), Assessment and restoration of biodiversity in a degraded ecosystem. Environmental Ministry and Agency of Science and Technology of Korea, Seoul, pp 163-242 (in Korean).

Korea Forest Research Institute. 1995. Our village groves, traditional reserved forests for pubic security in Korea. Korea Forest Service, Seoul (in Korean).

Lee D, Park CR. 2004. Ecological functions and losses of Korean traditional village groves. The Third Korea-Mongolian joint seminar on Environmental Changes in North East Asia, 14-18 September. 2004, Ulaanbaatar, Mongolia.

Lee D, Shin JH. 2003. Hierarchy concept embedded in the Baekdudaegan System. Korean J Quat Res 17: 17-26 (in Korean with English abstract).

Lee WS, Park CR. 1995. Analysis of changes on the forest environment and the bird community in terms of 'guild'. Korean J Ecol 18: 397-408 (in Korean with English abstract).

Luetz M, Bastian O. 2002. Implementation of landscape planning and nature conservation in the agricultural landscape - a case study from Saxony. Agric Ecosyst Environ 92: 159-170.

Park CR, Lee WS. 2002. Effects of fragmentation on the bird community in agricultural landscapes. Korean J Environ Ecol 16(1): 22-33 (in Korean with English abstract).

Park CR, Lee WS. 2000. Relationship between species composition and area in breeding birds of urban woods in Seoul, Korea. Landsc Urban Plan 51: 29-36.

Radeloff VC, Hammer RB, Stewart SI. 2005. Rural and suburban sprawl in the U.S. Midwest from 1940 to 2000 and its relation to forest fragmentation. Conserv Biol 19(3): 793-805.

Wegner JF, Merriam G. 1979. Movements by birds and small mammals between a wood and adjoining farmland habitats. J Appl Ecol 16: 349-357.

Won PO. 1981. Illustrated flora and fauna of Korea (avifauna). vol. 25. Ministry of education (in Korean).

*(Received February 2, 2006; Accepted April 10, 2006)*

Appendix 1. Diameter at breast height (means + standard deviation) of each tree species at the study areas

| Scientific name | A[a] | B | C | D | E | F | Freq. |
|---|---|---|---|---|---|---|---|
| *Zelkova serrata* | 60.6 + 14.5 (30) | 62.8 + 29.5 (120) | 45.6 + 46.9 (25) | 63.6 + 31.1 (20) | 59.8 + 22.2 (95) | 55.7 + 49.7 (46) | 1.00 |
| *Celtis sinensis* | 45.1 + 16.7 (12) | 75.7 + 29.5 ( 31) | 55.8 + 31.8 ( 3) | 44.8 + 24.8 (17) | 79.6 + 27.7 (25) | | 0.83 |
| *Prunus serrulata* var. *spontanea* | | 15.4 + 6.4 ( 18) | 6.1 + 3.4 (20) | | 10.5 + 3.6 ( 4) | 18.4 + 4.3 ( 7) | 0.67 |
| *Ulmus parvifolia* | | | 46.5 + 0 ( 1) | 42.6 + 10.6 ( 5) | | 22.1 + 7.6 ( 2) | 0.50 |
| *Pinus densiflora* | | | | 38.0 + 15.6 (11) | | 41.9 + 7.0 (15) | 0.33 |
| *Quercus acutissima* | | | | 43.7 + 9.1 ( 8) | | 73.1 + 28.6 ( 5) | 0.33 |
| *Pinus thunbergii* | | 70.7 + 0 ( 1) | 27.2 + 1.3 ( 2) | | | | 0.33 |
| *Ginko biloba* | | 34.1 + 11.0 ( 5) | | 8.67 + 2.49 ( 3) | | | 0.33 |
| *Lagerstroemia indica* | | 7.5 + 0.9 ( 4) | | | 7.5 + 0.9 ( 4) | | 0.33 |
| *Salix chaenomeloides* | 98.0 + 0 (1) | | | 63.5 + 26.5 ( 2) | | | 0.33 |
| *Carpinus tschonoskii* | | 37.0 + 18.7 ( 15) | | | 38.6 + 19.2 (10) | | 0.33 |
| *Robinia pseudoacacia* | | | | 45.0 + 0 ( 1) | | 22.0 + 8.5 (10) | 0.33 |
| *Fraxinus rhynchophylla* | | | | | | 27.3 + 14.4 (10) | 0.17 |
| *Pinus koraiensis* | | | | | | 19.5 + 8.9 (10) | 0.17 |
| *Aphananthe aspera* | | 141.7 + 0 ( 1) | | | | | 0.17 |
| *Quercus dentata* | | | | | | 43.9 + 22.0 ( 7) | 0.17 |
| *Castanea crenata* | | | | | | 38.0 + 0 ( 1) | 0.17 |
| *Salix matsudana* for. *tortuosa* | | | | 46.0 + 1.0 ( 2) | | | 0.17 |
| *Kalopanax pictum* | | | | | | 49.2 + 34.3 ( 3) | 0.17 |
| *Abies hollophylla* | | | | | | 24.7 + 11.9 (18) | 0.17 |
| *Quercus serrata* | | | | | | 53.4 + 32.9 ( 3) | 0.17 |
| *Diospyros lotus* | | 10.4 + 3.3 ( 4) | | | | | 0.17 |
| *Cornus macrophylla* | | | | | | 39.7 + 4.7 ( 2) | 0.17 |
| *Platycarya strobilacea* | | | | | | 31.0 + 0 ( 1) | 0.17 |
| *Pruns padus* | | | | | | 29.4 + 9.1 ( 6) | 0.17 |
| *Larix kaempferi* | | | | | | 47.1 + 0 ( 1) | 0.17 |
| *Camelia japonica* | | 10.7 + 0.3 ( 2) | | | | | 0.17 |
| *Chaenomeles sinensis* | | | | 115.0 + 0 ( 1) | | | 0.17 |
| *Hibiscus syriacus* | | 8.5 + 0 ( 2) | | | | | 0.17 |
| *Fraxinus sieboldiana* | | | | | | 22.0 + 0 ( 1) | 0.17 |
| *Acer saccharinum* | | | | | | 16.9 + 9.6 ( 4) | 0.17 |
| *Cornus controversa* | | 11.0 + 0 ( 1) | | | | | 0.17 |
| *Chamaecyparis obtusa* | | | 5.0 + 0 (166) | | | | 0.17 |
| *Juniperus chinensis* | | | | | | 44.6 + 0 ( 1) | 0.17 |
| *Populus alba x glandulosa* | | 21.8 + 0 ( 1) | | | | | 0.17 |
| Number of species | 3 | 13 | 6 | 10 | 5 | 20 | |
| Number of individuals | 43 | 205 | 217 | 70 | 138 | 153 | |
| Tree density (ea/100m$^2$) | 3.44 | 1.12 | 8.68 | 2.92 | 1.56 | 2.35 | |
| Area (m$^2$) | 1250 | 18274 | 2500 | 2400 | 8829 | 6500 | |
| History (year) | 315 | 404 | 809 | 374 | 490 | 644 | |

[a] A: Sanggok-ri, B: Hyanggyo-ri, C: Anyoung, D: Gamsan, E: Beopsungpo, F: Boryong-ri.