Distribution of Bird Habitats Using UCD-image Analysis : the Case of the Shinshu University Campus Research Forest

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Abstract : The habitat of forest bird species depends on forest type. We analyzed the distribution of birds inhabiting the Shinshu University Agriculture Faculty's campus research forest. A bird observation database and image classification were used to complete the analysis. Birds were most frequently observed in broad-leaved forest areas of the campus forest, but this differed slightly among species. Thus, our results showed differences between species.

Introduction

Tree species is a factor affecting the habitat of forest bird species. Tree species play a big role in the forest environment and its features. We examined the tendency of birds to use a forest, based on forest type. Image classification with remote sensing technology was used to identify individual trees to species.

Materials and Methods

Study area

The survey area was the Agriculture Faculty of Shinshu University's campus research forest in Minamiminowa Village, Nagano Prefecture. The elevation of the study area was about 770 m above sea level. The total area was about 23 ha and the trees were 15-80 years old. The forest featured extensions of a field and the residential quarters around the university campus. In the study area, both forest and grassland bird species were found. The main tree species were red pine, larch, cypress, and broad-leaved trees. Additionally, cherry, maple, and lacquer trees grew on the forest grounds.

Survey

The route census method was used to investigate the birds inhabiting the forest. Data were collected early in the morning for 1 hour, a total of 47 times from May 2007 to March 2008. Data were collected regarding bird appearance position, species, bird abundance, and behavior. Appearance position was the first point at which the observer noticed the bird by shape or song[1]. A database was made in ArcGIS 9.1 from the survey results.

There were 52 species of birds observed, for a total of 4389 individuals. Species and total species numbers are shown in Table 1.

Data analysis

First we created a figure of tree species for image classification from the UCD 4 band image using MultispecWin32 and the training area classification method[2]. There were six classes : broad-leaved forest, red pine, larch, cypress, non-forest area, and shadow (Fig. 1). Then, a circle buffer of 1, 5, or 10 m was centered on each bird appearance position (Fig. 2). Next, the image for classification was created using the ArcGIS function "clip" (Fig. 3). Finally, we calculated the cut out layer size by each tree type and converted it to an area percentage (Fig. 4-7).

Results

We observed three main species, *Parus major, Hypsipetes amaurotis,* and *Carduelis sinica,* which are the main bird species in the campus forest[3].

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Table 1. Survey result by route census method

Species name	number	Species name	number
Milvus migrans	11	*Phylloscopus borealis*	3
Butastur indicus	2	*Phylloscopus borealoides*	3
Buteo buteo	28	*Ficedula narcissina*	16
Falco peregrinus	1	*Cyanoptila cyanomelana*	6
Steptopelia orientails	111	*Muscicapa dauurica*	6
Sphenurus sieboldii	31	*Aegithalos caudatus*	204
Cuculus canorus	19	*Parus montanus*	5
Dendrocopos major	144	*Parus ater*	19
Dendrocopos kizuki	104	*Parus varius*	13
Alauda arvensis	2	*Parus major*	1060
Hirundo rustica	61	*Zosterops japonicus*	101
Delichon dasypus	7	*Emberiza cioides*	149
Motacilla cinerea	52	*Emberiza rustica*	94
Motacilla grandis	10	*Emberiza elegans*	23
Motacilla alba	39	*Emberiza spodocephala*	5
Anthus hodgsoni	50	*Fringilla montifringilla*	34
Hypsipetes amaurotis	608	*Carduelis sinica*	351
Lanius bucephalus	42	*Eophona personata*	23
Tarsiger cyanurus	8	*Coccothraustes coccothraustes*	3
Phoenicurus auroeus	13	*Passer montanus*	210
Turdus cardis	108	*Sturunus philippensis*	41
Turdus chrysolaus	16	*Sturnus cineraceus*	161
Turdus pallidus	8	*Garrulus glandarius*	77
Turdus naumanni	26	*Cyanopica uyana*	30
Cettia diphone	22	*Corvus corone*	61
Acrocephalus orientalis	2	*Corvus macrorhynchos*	66

1. *Parus major*

Parus major was most commonly observed in the broad-leaved forest, about 25% of the time. Red pine, larch, and cypress were the next most common habitat, each accounting for 15% of the observations. Moreover, *P. major* were observed in non forest areas about 10% of the time. The other species were observed in non-forest more frequently.

2. *Hypsipetes amaurotis*

Hypsipetes amaurotis was most often observed in broad-leaved forest, accounting for about 25% of sightings. Red pine, larch, cypress, and non-forest each represented about 15% of observations. *Hypsipetes amaurotis* were seen in the broad-leaved forest and each conifer type at about the same rate as *P. major*. However, *H. amaurotis* were seen more frequently in non-forest than *P. major*, indicating that *H. amaurotis* may be more adjusted to an urban environment than *P. major*.

3. *Carduelis sinica*

Carduelis sinica was observed in broad-leaved forest less than 25% of the time. This was the lowest among the three species. *Carduelis sinica* was observed in non-forest areas over 20% of the time, which was the highest among the three

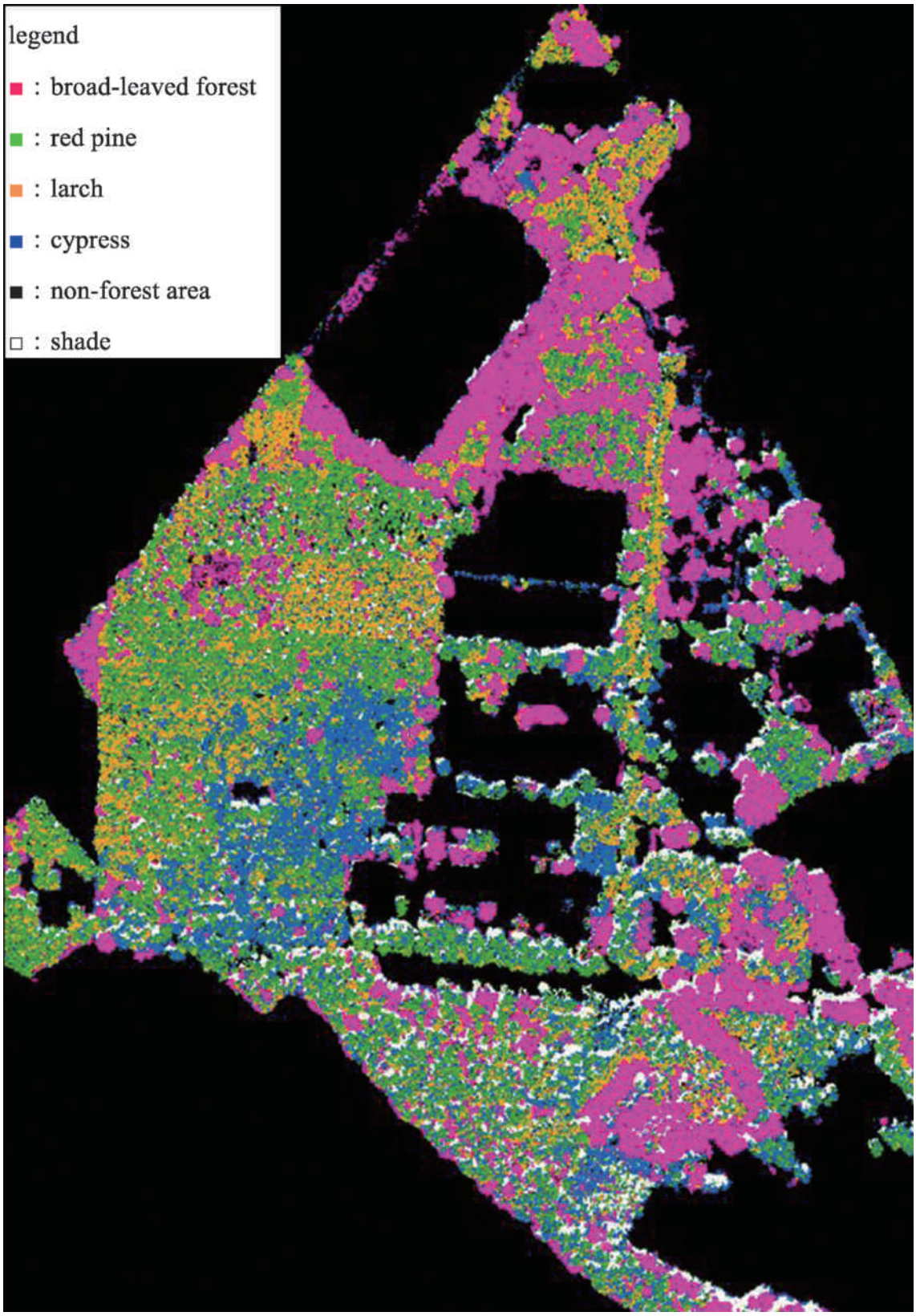

Figure.1 Tree species classification image using high resolution UCD airborne data

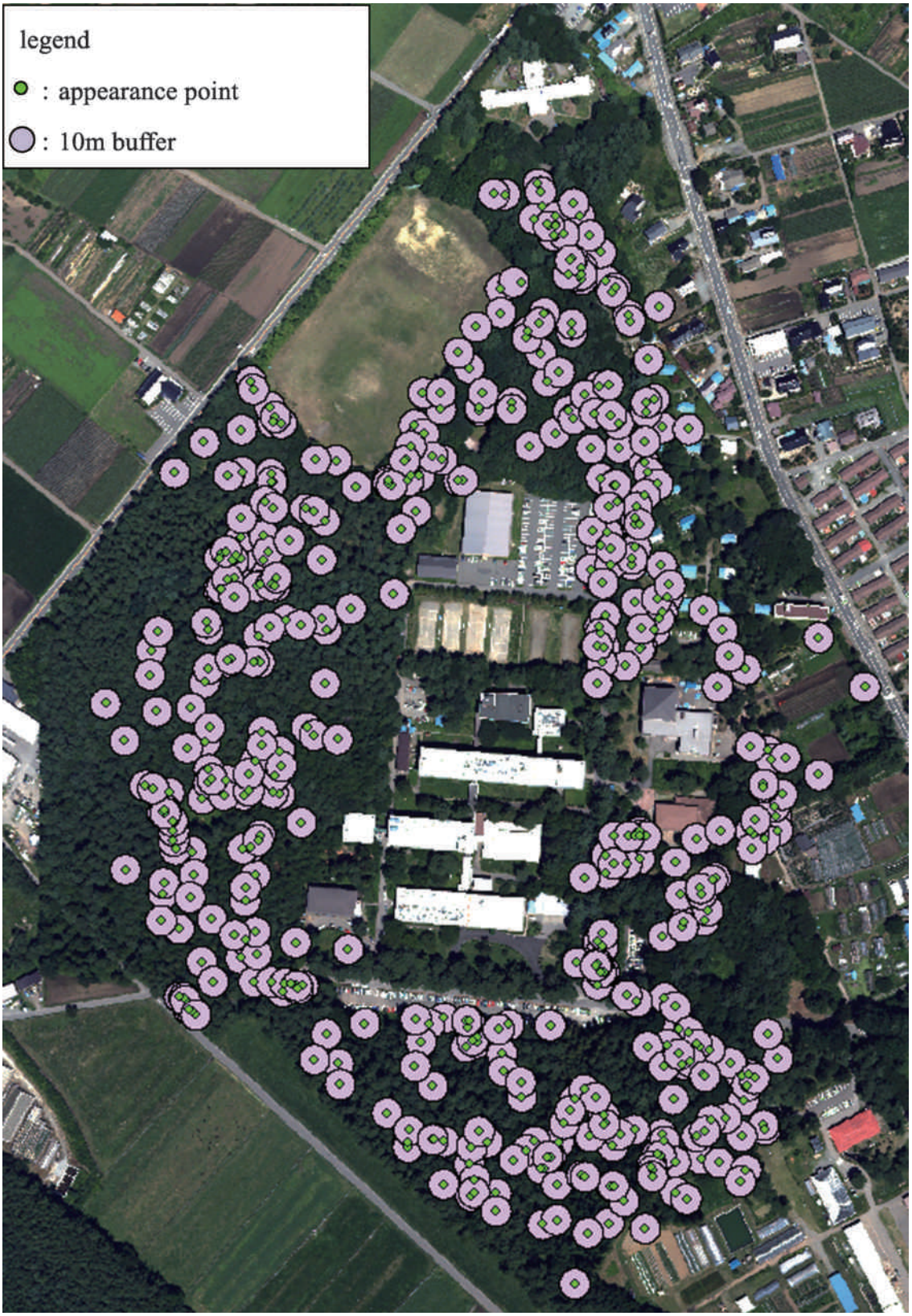

Figure.2 10m circle buffer on *Parus major* appearance position

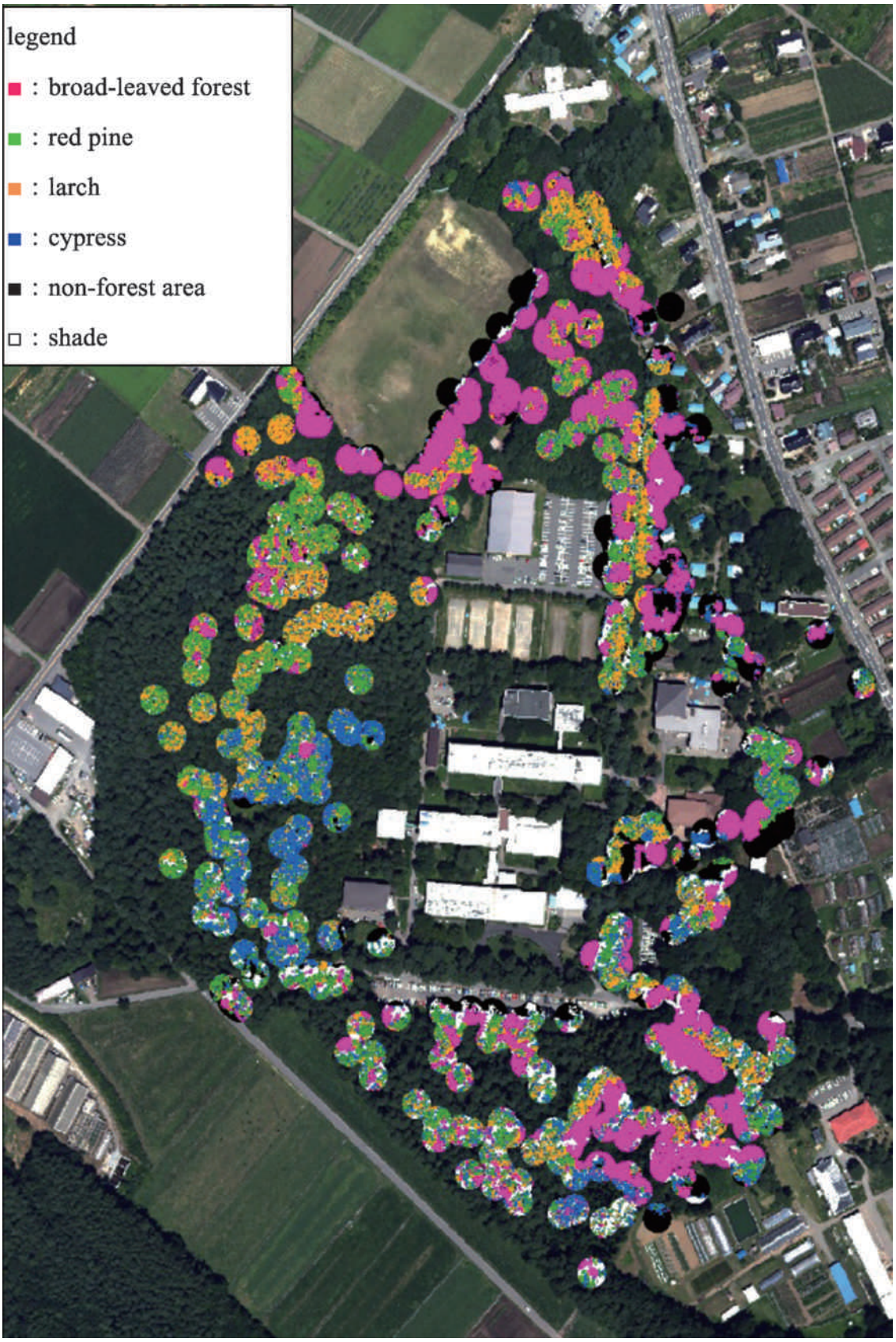

Figure.3 Habitat classification image of *Parus major* clipped by 10m circle buffer

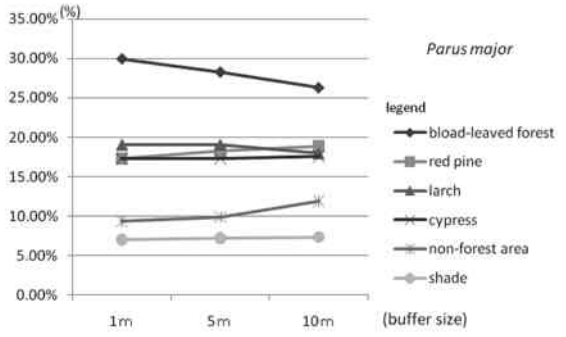

Figure.4 *Parus major* habitat ratio

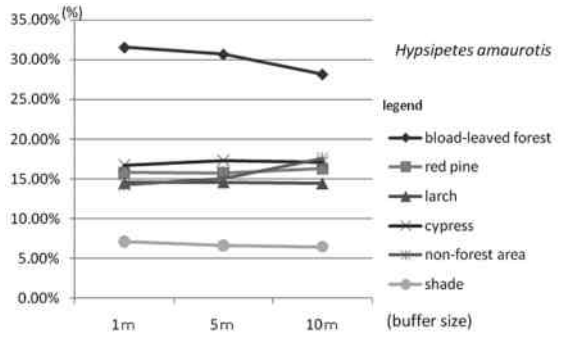

Figure.5 *Hypsipetes amaurotis* habitat ratio

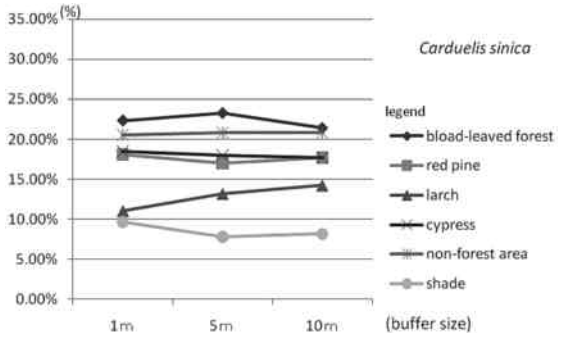

Figure.6 *Carduelis sinica* habitat ratio

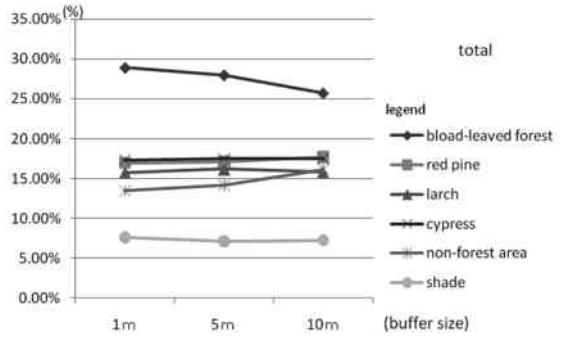

Figure.7 total habitat ratio

species. *Parus major* and *H. amaurotis* are forest birds, but *C. sinica* lives in grassland. These results reflect *C. sinica's* preferred habitat.

Conclusions

In each species, individuals were most frequently found in the broad-leaved forest. In general, broad-leaved forests are rich in biodiversity. Red pine, larch, and cypress had about the same frequency of observations for each species. This result indicates that conifer environments did not have specific features. The percentage of bird sightings in broad-leaved forests increased when a small buffer was used. However, the percentage of bird sightings in non-forest areas increased with a large buffer. The reason for this difference is that broad-leaved trees grow at the forest edge. A large buffer includes areas outside the forest. Thus, a large buffer increases the percentage of bird observations that occurred non-forest areas.

Each bird species had a different forest type ratio. Thus, using remote sensing technology was effective for this analysis of bird habitat trends. However, birds habitat trends change with various elements, such as forest size, component tree species, and altitude. Therefore, further studies are needed, comparing many areas.

Reference

1) Toshikazu Onisi (2000) Birds of Japan 590, Heibonsya, Tokyo, 654pp
2) Masato Katoh (2004) Forest remote sensing : applications from introduction, J-FIC, Tokyo, 273pp
3) Mario Naruse and Masato Katoh (2009)The relation between bird type and forest type in the Shinshu University Campus Forest during the breeding season, Chubu Forestry Research **56** : 83-84