



Distribution Characteristics of Birds in Dongbokcheon Stream and Dongbokho Reservoir

Seon Deok Jin¹, Gi Chang Bing^{2,4}, Woon Kee Paek^{1*}, and Doo Pyo Lee^{3*}

¹Division of Natural History, National Science Museum, Daejeon 305-705, Korea

²Migratory Birds Center, Korea National Park Service, Sinan 535-916, Korea

³Department of Biological Science, Honam University, Gwangju 506-714, Korea

⁴Department of Biology, Chosun University, Gwangju 501-759, Korea

Abstract: This study was conducted from May until December 2005, once per season, to estimate the distribution of birds in Dongbokcheon stream. The results of the study showed 70 species and 2,420 individuals, which 32 species and 349 individuals during the spring, 39 species and 548 individuals during summer, 39 species and 459 individuals during the fall and 43 species and 1,064 individuals during the winter. The Dominant species included *Paradoxornis webbianus* (12.60%), *Mergus merganser* (9.75%), *Passer montanus* (8.84%), *Emberiza elegans* (6.49%), *Streptopelia orientalis* (5.21%), *Anas poecilorhyncha* and *Cyanopica cyana* (5.00%). The number of species per distance (km) was the highest in site 3 at 6.4 species and 97.6 individuals, followed by site 1 (5 species and 78.3 individuals) and then site 2 (3.4 species and 71.8 individuals). The results were similar to species diversity as well, with site 3 showing the highest at 3.20, followed by site 1 (3.07) and then site 2 (2.78). In terms of dominant species, site 1 and 3 were the most dominant at passerine birds with exception of egrets. But site 2 showed the highest rate at waterfowl. The species diversity of waterfowl, site 2 showed the highest number of species (13 species and 407 individuals) at 52.7%, with site 1 showing the lowest (12 species and 129 individuals) at 18.3%.

Key words: Dongbokcheon stream, Dongbokho reservoir, Dam, Distribution of birds

Introduction

It has evolved through thousands of years that the stream balanced with ecological function of inhabited organism with natural changing patterns of stream flow.

With the current rapid increase in industrialization and population growth, there has been an increase in the demand for industrial and person use of water. For such demand, dams are created as not only a measure of artificially managing water, but also as a measure of controlling flood and water level. However, dams cause a number of interferences in terms of sustaining river ecosystem (Sandra and Brian 2003).

Dongbokcheon stream starts from the Baekasan (Mt.) of Hwasun-gun of the region of Jeollanam-do and joins the Boseong River of Seomjin River in becoming the Seomjin River's secondary branch, at a total length of 55.42 km and surface area of 388 km². The river runs through 5 myeons of Hwasun-gun in Jeollanam-do, and while the main stream

is referred to as Seomjin River, the first branch is called Boseong River (Lim *et al.* 2004). Dongbokcheon stream is currently controlled by the Dongbok Dam, and the stream which flows through joining by Juamho (lake), making the stream quite unique as it is located between two dams (Min 2006).

Studies on the avifauna of Dongbokcheon stream are nonexistent with the exception of "Avifauna of Dongbok Stream, Jeollanam-do" by Kang and Lee (2003), and no studies are being conducted on the Dongbok Dam. Therefore, this study was conducted in order to estimate the avifauna of the upstream and downstream of the Dongbok Dam.

Material and Methods

The study on the avifauna of Dongbokcheon stream was conducted from May until December 2005, and was conducted once each season. Site 1 included the region from Won-ri 3 gyo bridge (Won-ri, Buk-myeon in Hwasun-gun of Jeollanam-do province) to Seoyugyo bridge of Seoyu-ri (9 km), and this region is the upper region of Dongbokcheon stream, characterized by farming grounds and forests and close distance to town. Site 2 included the

*To whom correspondence should be addressed.

Tel: +82-62-940-5434

E-mail: dplee@honam.ac.kr (D. P. Lee)

Tel: +82-42-601-7989

E-mail: paekwk@mest.go.kr (W. K. Paek)

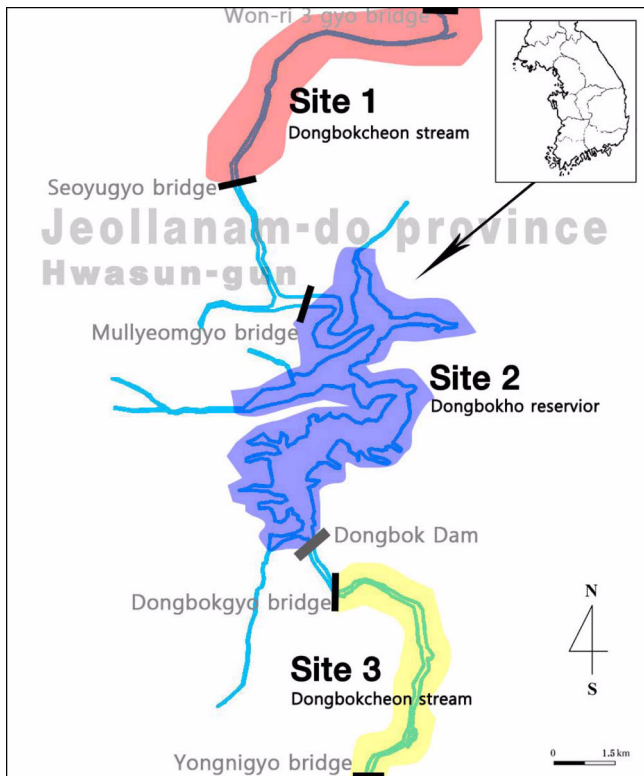


Fig. 1. Site 1: From Won-ri 3 gyo bridge (Won-ri, Buk-myeon in Hwasun-gun of Jeollanam-do province) to Seo-yugyo bridge of Seo-yu-ri (9 km), Site 2: Between Mullyeomgyo bridge (Changnang-ri, Iseo-myeon, Hwasun-gun) and Dongbok Dam of Seo-ri in Iseo-myeon (13 km), Site 3: Between the Dongbokgyo bridge (Doksang-ri, Dongbok-myeon, Hwasun-gun) and the Yongnigyo bridge of Yong-ri in Nam-myeon (8 km)

area between Mullyeomgyo bridge (Changnang-ri, Iseo-myeon, Hwasun-gun) and Dongbok Dam of Seo-ri in Iseo-myeon (13 km) and included the region of Dongbokho, with the site being characterized primarily by flat water and being close to forest area. Site 3 included the land between the Dongbokgyo bridge (Doksang-ri, Dongbok-myeon, Hwasun-gun) and the Yongnigyo bridge of Yong-ri in Nam-myeon (8 km) and was characterized primarily by downstream, with relatively wide stream and flat water, and was close to farming grounds and towns (Fig. 1).

With each team including two individuals, the teams moved along footpath and counted the number of species and individuals on the other side using either a binocular (Nikon 8×42) or a telescope (Swarovski 20×~60×), along with sounds of the birds, to be recorded along with time, environment and location. Both the point census method and the line transect method were used, and the study area incorporated all areas visible with either the naked eye or a binocular, with no repetition in bird count (Bibby *et al.* 1992).

The species names were recorded following the taxonomy by Howard and Moore (1998) and documentation by Lee *et al.* (2000). Endangered species and natural monument

species were recorded using literatures by Yee (2009) and NIER (2006).

(1) Dominance (Dom.): Shows which bird species account what percentage of the total bird count (McNaughton and Wolf. 1967).

$$D = ni/N \times 100$$

(N: total bird count/ni: The bird count of the Ith species)

(2) Species diversity (H'): Assessed using the Shannon - Weaver function (Pielou, 1966) developed from theory by Marglef (1968).

$$H' = -\sum Pi \ln Pi$$

(Pi=ni/N)

Results

Avifauna

Between May and December of 2005, the total number of individuals were 2,420 of 70 species, with spring including 349 individuals of 32 species, summer including 548 individuals of 39 species, fall including 459 individuals of 39 species and winter including 1,064 individuals of 43 species, and the winter season showed the highest number of individuals and species (Table 1).

Dominant species included the *Paradoxornis webbianus* (12.60%), *Mergus merganser* (9.75%), *Passer montanus* (8.84%), *Emberiza elegans* (6.49%), *Streptopelia orientalis* (5.21%), *Anas poecilorhyncha* (5.00%) and *Cyanopica cyana* (5.00%). Most of the seasons showed dominance of forest birds living near towns and forests, and the winter season showed dominance in Mergansers, which favor deep reservoirs as their habitat (Table 2).

In terms of categorization via migration, Residents showed the highest number of species at 28 species (40%), followed by Summer Visitors at 23 species (32.9%), and these two categories made up 72.9% of the total. Furthermore, Winter Visitors showed 15 species (21.4%), followed by birds of Passage Migrants at 4 species (5.7%) (Table 1).

Species diversity was 3.32, and the summer showed the highest value of 3.00, followed by 2.99 for spring, 2.96 for fall and 2.72 for winter (Table 1).

Regional avifauna

Site 1 is located near farming grounds and roads, with the dikes covered with grassland and the riverbed dotted with pebbles, sand and grassland. A total of 45 species, 705 individuals were observed, with the dominant species being *Passer montanus* (14.61%), *Paradoxornis webbianus* (11.49%) and *Emberiza elegans* (9.08%), with species diversity at 3.07 (Table 1).

Table 1. The List of birds observed on Dongbok Stream from May to December, Korea

Scientific Name	Korean Name	Site1		Site2		Site3		Total		Mig**
		N.I*	Dom.	N.I	Dom.	N.I	Dom.	N.I	Dom.	
<i>Podiceps ruficollis</i>	논병아리			4	0.43	6	0.77	10	0.41	Res
<i>Podiceps cristatus</i>	빨논병아리			3	0.32			3	0.12	WV
<i>Ixobrychus sinensis</i>	덤불해오라기					6	0.77	6	0.25	SV
<i>Nycticorax nycticorax</i>	해오라기			1	0.11			1	0.04	SV
<i>Butorides striatus</i>	검은댕기해오라기	8	1.13	2	0.21	19	2.43	29	1.20	SV
<i>Bubulcus ibis</i>	황로	11	1.56			11	1.41	22	0.91	SV
<i>Egretta alba modesta</i>	중대백로	21	2.98	11	1.18	15	1.92	47	1.94	SV
<i>Egretta intermedia</i>	중백로			1	0.11	2	0.26	3	0.12	SV
<i>Egretta garzetta</i>	쇠백로	41	5.82	24	2.57	21	2.69	86	3.55	SV
<i>Ardea cinerea</i>	왜가리	26	3.69	45	4.82	25	3.20	96	3.97	SV
<i>Aix galericulata</i>	원앙			3	0.32	2	0.26	5	0.21	Res
<i>Anas platyrhynchos</i>	청둥오리			59	6.32			59	2.44	WV
<i>Anas poecilorhyncha</i>	흰뺨검둥오리			95	10.17	26	3.33	121	5.00	WV
<i>Anas crecca</i>	쇠오리			9	0.96			9	0.37	WV
<i>Mergus merganser</i>	비오리			236	25.27			236	9.75	WV
<i>Mergus sguamatus</i>	호사비오리			5	0.54			5	0.21	WV
<i>Accipiter soloensis</i>	붉은배새매					1	0.13	1	0.04	SV
<i>Accipiter nisus</i>	새매					2	0.26	2	0.08	WV
<i>Buteo buteo</i>	말뚝가리	1	0.14	1	0.11	1	0.13	3	0.12	WV
<i>Falco tinnunculus</i>	황조롱이	3	0.43			1	0.13	4	0.17	Res
<i>Phasianus colchicus</i>	꿩	2	0.28	4	0.43	4	0.51	10	0.41	Res
<i>Gallinula chloropus</i>	쇠물닭					8	1.02	8	0.33	SV
<i>Fulica atra</i>	물닭			1	0.11			1	0.04	WV
<i>Charadrius dubius</i>	꼬마물떼새	4	0.57			2	0.26	6	0.25	SV
<i>Charadrius placidus</i>	흰목물떼새	9	1.28			4	0.51	13	0.54	Res
<i>Tringa ochropus</i>	백뺨도요	1	0.14			6	0.77	7	0.29	PM
<i>Tringa glareola</i>	알락도요	2	0.28					2	0.08	PM
<i>Tringa hypoleucos</i>	깜작도요	4	0.57	1	0.11	5	0.64	10	0.41	PM
<i>Gallinago gallinago</i>	까도요	1	0.14			1	0.13	2	0.08	Res
<i>Gallinago solitaria</i>	청도요	1	0.14					1	0.04	WV
<i>Streptopelia orientalis</i>	멧비둘기	52	7.38	18	1.93	56	7.17	126	5.21	Res
<i>Cuculus micropterus</i>	검은등뺨꾸기					1	0.13	1	0.04	SV
<i>Apus pacificus</i>	칼새			26	2.78			26	1.07	SV
<i>Halcyon pileata</i>	청호반새	1	0.14			2	0.26	3	0.12	SV
<i>Alcedo atthis</i>	물총새	7	0.99	2	0.21	14	1.79	23	0.95	SV
<i>Eurystomus orientalis</i>	파랑새	4	0.57					4	0.17	SV
<i>Picus camus</i>	청딱다구리			2	0.21	4	0.51	6	0.25	Res
<i>Dendrocopos leucotos</i>	큰오색딱다구리					1	0.13	1	0.04	Res
<i>Dendrocopos kizuki</i>	쇠딱다구리	9	1.28	3	0.32	3	0.38	15	0.62	Res
<i>Hirundo rustica</i>	제비	9	1.28	7	0.75	9	1.15	25	1.03	SV
<i>Motacilla cinerea</i>	노랑할미새	6	0.85			3	0.38	9	0.37	SV
<i>Motacilla alba leucopsis</i>	알락할미새	13	1.84			22	2.82	35	1.45	SV
<i>Motacilla alba lugens</i>	백할미새	1	0.14			2	0.26	3	0.12	WV
<i>Motacilla grandis</i>	검은등할미새	10	1.42			21	2.69	31	1.28	Res
<i>Anthus hodgsoni</i>	형등새					8	1.02	8	0.33	PM
<i>Anthus spinoletta</i>	밭중다리	7	0.99			15	1.92	22	0.91	WV
<i>Hypsipetes amaurotis</i>	직박구리	29	4.11	33	3.53	22	2.82	84	3.47	Res
<i>Lanius bucephalus</i>	매까치	3	0.43	1	0.11	6	0.77	10	0.41	Res
<i>Prunella montanella</i>	멧중다리	1	0.14	1	0.11			2	0.08	WV
<i>Erithacus cyane</i>	쇠유리새			2	0.21			2	0.08	SV
<i>Phoenicurus aureoreus</i>	딱새	7	0.99	4	0.43	4	0.51	15	0.62	Res
<i>Turdus pallidus</i>	흰배지빠귀			5	0.54			5	0.21	SV
<i>Paradoxornis webbiana</i>	붉은머리오목눈이	81	11.49	97	10.39	127	16.26	305	12.60	Res
<i>Acrocephalus arundinaceus</i>	개개비					6	0.77	6	0.25	SV
<i>Aegithalos caudatus</i>	오목눈이	3	0.43	10	1.07			13	0.54	Res
<i>Parus palustris</i>	쇠박새	2	0.28	4	0.43			6	0.25	Res
<i>Parus ater</i>	진박새			5	0.54			5	0.21	Res

Table 1. Continued

Scientific Name	Korean Name	Site1		Site2		Site3		Total		Mig
		N.I	Dom	N.I	Dom	N.I	Dom	N.I	Dom	
<i>Parus varius</i>	곤줄박이	5	0.71	4	0.43	2	0.26	11	0.45	Res
<i>Parus major</i>	박새	24	3.40	30	3.21	16	2.05	70	2.89	Res
<i>Emberiza cioides</i>	멧새	1	0.14					1	0.04	Res
<i>Emberiza rustica</i>	쭈새	10	1.42	4	0.43	80	10.24	94	3.88	WV
<i>Emberiza elegans</i>	노랑턱멧새	64	9.08	32	3.43	61	7.81	157	6.49	Res
<i>Fringilla montifringilla</i>	되새	14	1.99					14	0.58	WV
<i>Passer montanus</i>	참새	103	14.61	44	4.71	67	8.58	214	8.84	Res
<i>Sturnus cineraceus</i>	찌르레기	4	0.57	2	0.21	4	0.51	10	0.41	Res
<i>Oriolus chinensis</i>	피꼬리	2	0.28	3	0.32	3	0.38	8	0.33	SV
<i>Garrulus glandarius</i>	어치	5	0.71	7	0.75	9	1.15	21	0.87	Res
<i>Cyanopica cyana</i>	물까치	42	5.96	70	7.49	9	1.15	121	5.00	Res
<i>Pica pica</i>	까치	51	7.23	13	1.39	15	1.92	79	3.26	Res
<i>Corvus macrorhynchos</i>	큰부리까마귀					21	2.69	21	0.87	Res
Number of Species		45		44		51		70		
Number of Individuals		705		934		781		2,420		
Species diversity (H')		3.07		2.78		3.20		3.32		

*NI: Number on Individual, Dom: Dominance, **Mig: Migrant, Res: Resident, SV: Summer Visitor, WV: Winter Visitor, PM: Passage Migrant

Site 2 is included in the region of Dongbokho and is surrounded by producing districts with waterside characterized by grassland, and a number of stream-related construction work and water quality control works of Dongbokho Iseocheon stream are taking place. A total of 44 species, 934 individuals were observed, with dominant species including *Mergus merganser* (25.27%), *Paradoxornis webbiana* (10.39%) and *Anas poecilorhyncha* (10.17%), with species diversity of 2.78 (Table 1).

Site 3 is included in the downstream region of Dongbokcheon stream with wide streams, and with relatively large marsh area. The location is near roads, so the area experiences a high level of human traffic. A part of the area is surrounded by producing area and is close to farming land and fruit farms. A total of 51 species, 781 individuals were observed, with dominant species including *Paradoxornis webbiana* (16.26%), *Mberiza rustica* (10.24%) and *Passer montanus* (8.58%), with species diversity of 3.20 (Table 1).

Endangered species

Between May and December of 2005, a total of 7 endangered species, 33 individuals were observed. The Natural monuments designated Cultural Heritage Administration of Korea was *Accipiter soloensis* (No. 323-

2), *Accipiter nisus* (No. 323-4), *falco tinnunculus* (No. 323-8) and *Axis galericulata* (No. 327). A single *Accipiter soloensis* was observed in site 3 during the summer, and two *Accipiter nisus* were seen in site 2 during the winter. In the case of *Axis galericulata*, one was seen in site 2 and two in site 3 during the summer and two seen in site 2 during the autumn season. The *falco tinnunculus* was seen in site 1 (1 individual) and site 2 (1 individual) during the autumn and in site 1 (2 individuals) during the winter. Class-II of Endangered species designated Ministry of Environment, *Buteo buteo*, *Mergus squamatus* and *Charadrius placidus* were observed. *Buteo buteo* was found in site 1 (1 individual), site 2 (1 individual) and site 3 (1 individual) during the winter, and *Mergus squamatus* was found in site 2 (5 individuals) during the winter. *Charadrius placidus* was found in site 1 (1 individual), site 3 (2 individuals) during the summer, in site 1 (2 individuals) and site 3 (1 individual) during the summer, in site 1 (6 individuals) and site 3 (1 individual) during the winter. Regional endangered species, 3 species 13 individuals were observed in site 1, followed by 10 individuals of 4 species in site 2 and 10 individuals of 5 species in site 3, with site 3 showing the highest number of species and site 1 showing the highest bird count (Table 3).

Table 2. Comparison of dominant species by season on Dongbok Stream

Rank	Whole	Spring	Summer	Autumn	Winter
1	<i>Paradoxornis webbiana</i> (12.60%)	<i>Passer montanus</i> (15.19%)	<i>Paradoxornis webbiana</i> (16.61%)	<i>Paradoxornis webbiana</i> (18.30%)	<i>Mergus merganser</i> (22.18%)
2	<i>Mergus merganser</i> (9.75%)	<i>Ardea cinerea</i> (12.61%)	<i>Cyanopica cyana</i> (11.68%)	<i>Passer montanus</i> (13.07%)	<i>Emberiza elegans</i> (14.57%)
3	<i>Passer montanus</i> (8.84%)	<i>Hypsipetes amaurotis</i> , <i>Parus major</i> (8.31%)	<i>Passer montanus</i> (11.13%)	<i>Motacilla alba</i> , <i>Cyanopica cyana</i> (6.11%)	<i>Paradoxornis webbiana</i> (9.87%)

Table 3. Endangered species recorded in Dongbok Stream from May to December, 2005

Index	Area	Site 1	Site 2	Site 3
A Natural Monument	<i>Accipiter soloensis</i> (No. 323-2)	-	-	Summer (1)
	<i>Accipiter nisus</i> (No. 323-4)	-	-	Winter (2)
	<i>Falco tinnunculus</i> (No. 323-8)	Autumn (1) Winter (2)	Autumn (1)	-
	<i>Aix galericulata</i> (No. 327)	-	Summer (1) Autumn (2)	Summer (2)
Endangered Species (II)	<i>Mergus sguamatus</i> (No. 448)	-	Winter (5)	-
	<i>Buteo buteo</i>	Winter (1)	Winter (1)	Winter (1)
	<i>Charadrius placidus</i>	Summer (1) Autumn (2) Winter (6)	-	Summer (2) Autumn (1) Winter (1)
Total		3 species 13 individuals	4 species 10 individuals	5 species 10 individuals

Table 4. Comparison of same season with those of other study

	Current study	Kang and Lee (2003)
Number of Species	20	29
Number of Individuals	96	219
Dominance species	<i>Passer montanus</i> , <i>Paradoxornis webbiana</i> , <i>Parus major</i>	<i>Acrocephalus arundinaceus</i> , <i>Sturnus cineraceus</i> , <i>Streptopelia orientalis</i>

Discussion

The value of 2,420 individuals of 70 species observed in Dongbokcheon stream was greater than the value of 714 individuals of 45 species recorded by Kang and Lee (2003). This is due to the fact that this study has included the Dongbokcheon upstream, Dongbokho and downstream, while the study by Kang and Lee (2003) was conducted between March and May on only the downstream region. Therefore, comparing the May data of the study by Kang and Lee (2003) to that of this study shows that, in the case of site 3 (May) the figures are both low at 219 individuals of 29 species and 96 individuals of 20 species, respectively. In the case of dominant species, while Kang and Lee (2003) included in their list *Acrocephalus arundinaceus*, *Sturnus cineraceus* and *Streptopelia orientalis*, this study has included *Passer montanus*, *Paradoxornis webbiana* and *Parus major*, showing that while the study by Kang and Lee (2003) showed species dominant in downstream reservoirs, this study showed species dominant near human habitat (Table 4). This may have been caused by the stream restoration works which started in 2004, but since the effect of such work on the ecosystem has not been studied, further research is necessary for clarification.

Artificial changes to a dam or stream environment leads to damage to the relevant ecosystem and eventually to the reduction in species diversity, as well as reduction in the quality of the ecosystem (Postel 1998). In the light of such

Table 5. Number of regional species and individuals per distance (km)

Index	Area	Site 1	Site 2	Site 3
Distance (km)		9 km	13 km	8 km
No. of species per distance		5.0	3.4	6.4
No. of individuals per distance		78.3	71.8	97.6

findings, in order to assess the species differences before and after the construction works done between May and December of 2005, taking into consideration the lack of research data on the species diversity before construction and that site 1 is similar to such pre-construction environment, site 2 and site 3 were compared, with findings as below.

In terms of the birds, since the habitats of the sites show differences, bird counts in relation to distance (km) were calculated for more accurate comparison. The value was the highest for site 3, at 97.6 individuals of 6.4 species, followed by site 1 (5 species, 78.3 individuals) and site 2 (3.4 species, 71.8 individuals) (Table 5). The findings were similar in the case species diversity as well; Site 3 showed the highest (3.20), followed by site 1 (3.07), then site 2 (2.78) (Table 5). For dominant species, site 1 and site 3 saw the dominance of forest birds, with the exception of egrets, but site 2 showed dominance by water birds. Taking into consideration the qualities of streams, looking at the rate of water birds, site 2 showed the highest at 52.7% (13 species,

Table 6. Regional species composition of water birds

Indes	Area	Site 1		Site 2		Site 3	
		NS	NI	NS	NI	NS	NI
Egrets		5	107	6	84	7	99
Ducks and Geese		-	-	6	407	2	28
Shorebirds		7	22	1	1	5	18
Total		12	129	13	492	14	145
Rates of No. of individuals on water birds (%)		18.3		52.7		18.6	

*NS: Number of species, NI: Number of individuals

407 individuals), with site 1 showing the lowest at 18.3% (12 species, 129 individuals) (Table 6).

Site 1 is near mountains, towns and farming areas and is a typical natural stream area with alluvial islands and riparian forests, while site 2 is characterized by high level of water and habitat grounds of flat water. In comparison to site 2, site 1 offers a wider range of habitats, so site 2 showed a greater bird count in comparison to distance (Table 5). In terms of birds, riparian forests showed higher species diversity in comparison to other habitat types, which brings to light the importance of riparian forests (Carothers 1974). However, among bird count rate of water birds, which prefer habitats with high level of sand and pebbles and low water level, such as shorebirds and egrets, showed high count in site 1 and 2, while ducks, which favor higher water level, were found in higher numbers in site 2. Furthermore, in the case on non-duck species, site 2 showed the highest level of dominance, and diving duck species favored water depth of between 1 and 2.5m as resting and sleeping grounds (Cramp and Simmons, 1977; Smith *et al.* 1989) and favored consistent water level and regions with low flow velocity (Kang *et al.*, 2008). In addition, site 3 showed high bird count in relation to distance (km) of all three sites (Table 6). This is predicted to be the result of habitats created artificially from past stream restoration works, variety is water depth, high marsh surface area and high level of river vegetation.

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