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A Comparative Study of Insect Community at Streamside zones at the Daejeon and Yudeung Streams[1]

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ABSTRACT

This study was conducted to identify the impact of river improvement efforts by studying terrestrial insects inhabiting at streamside locations at the Daejeon and Yudeung streams. Seven surveys were conducted from April to October on 2008 and the results were analyzed. Totally 428 species of 110 families belonging to 11 orders of insects were investigated during the course of the present study. The insects identified at the Daejeon stream belonged to 335 species, 99 families and 11 orders, while those at the Yudeung stream were of 350 species, with 98 families and 11 orders. At the Daejeon stream, D-1 and D-2 points were the sites where the most species(178 species) were identified, while at the Yudeung stream, the Y-1 point was the site where the most species(179 species) emerged. In a cluster analysis based on a similarity index, Group A(without river improvement works) and Group B(downtown passing area with river improvement works) were created. Within Group A, survey points were classified as the Daejeon stream group(the A-1 Group) and the Yudeung stream group(the A-2 Group). It was found that the emergence patterns of insects were related to regional characteristics of the streams.

KEY WORDS: TERRESTRIAL INSET, RIVER IMPROVEMENT, SIMILARITY INDEX

요 약

본 연구는 대전천과 유등천의 하천변에 서식하는 육상곤충을 이용해 하천정비공사가 인근 생물에 끼치는 영향을 알아보기 위한 것으로 2008년 4월부터 10월까지 총 7회에 걸쳐 조사를 수행하고 그 결과를 분석하였다. 조사기간 동안 출현한 곤충은 총 10목 110과 428종으로 대전천에서 조사된 곤충은 11목 99과 335종, 유등천에서 조사된 곤충은 11목 98과 350종이었다. 대전천은 D-1지점과 D-2지점에서 178종이 출현하여 가장 많은 종수가 확인되었고, 유등천은 Y-1지점에서 179종이 출현하여 가장 많은 종수가 확인되었다. 유사도 지수를 근거로 각 지점별 클러스터 분석을 실시해 본 결과, 하천정비공사가 진행되지 않은 지역(A그룹)과 하천정비공사가 진행된 도심관통 지역(B그룹)으로 그룹화 되었다. 또한 A그룹에서도 각 조사지점이 대전천(A-1그룹)과 유등천(A-2그룹)으로 나뉘어 하천의 지역적 차별성에 따른 곤충의 출현이 상대적임을 알 수 있었다.

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주요어: 육상곤충, 하천개발, 유사도지수

INTRODUCTION

Streamside areas serve to purify contaminants in streams while also serving as a form of shelter and habitat for various living things. They also stabilize the banks, have a recreation function, and provide a visual greenery resource(Ahn and Song, 2003). However, continuous river improvement works change streams, banks and streamside areas until eventually they do not perform their intended functions properly(Son, 1998). In particular, urban streams running through densely populated areas can sustain damage to the habitats of living things when they undergo river straightening projects or when bicycle paths, riverbed roads, parking lots, or athletic facilities which cover the rivers are constructed so as to utilize urban space at riversides. With the recent introduction of the concept of close-to-nature river improvements, many river improvement projects are being planned or are in progress. However, due to the insufficient information pertaining to stream ecosystems, stream landscape architecture or stream landscapes tend to be over-emphasized in favor of the preservation of the stream ecosystem(Namgung, 1999; Shoichiro *et al*., 2004). Much time and effort are required to restore a close-to-nature stream if the ecosystem is changed because of river improvement projects. Thus, more objective evaluations and expert opinions are required. In addition, river improvement projects should be performed with caution and care(Berit and Matthias, 2008).

As the importance of the environmental concept of streams has been emphasized, interest in close-to-nature streams is increasing, and studies focusing on birds, fish, and benthic macro-invertebrate related to stream decontamination efforts are actively being performed as part of the overall stream eco-system recovery project(Kim *et al*., 2002; Park, 2004; Cho, 1994; Cho, 2006). However, studies of terrestrial insects, which represent the greatest percentage in Arthropoda in the animal kingdom, show that they are a direct source of food for birds, amphibians and small mammalians and that they play an important role in ecosystems as a primary consumer. Such studies are, however, somewhat rare, with the exception of a few, such as those by Jung and Yeo (1996), and Jung(1997)(Bae *et al*., 2002). In a study on insects in relation to city development in Daejeon, 779 species, 149 families and 18 orders of terrestrial insects were identified(Nam and Kim, 1999). Additionally, as the Daejeon stream and Yudeung stream are city streams that penetrates dense urban areas as well as natural eco-streams, which have a direct influence on the natural eco-system at the same time(Lee *et al*., 1999), the habitats of terrestrial insects and their neighborhood ecosystems can be identified indirectly by comparing the downtown stream and eco-stream sections.

The Daejeon stream belongs to the Geum River system, the third tributary of the Geum River, and the first tributary stream of the Yudeung stream. It originates at Mt. Manin which is on the boundary of the neighborhood of Haso-dong, in the eastern part of the city of Daejeon, and the rural areas of Boksoo township and Chubu township in Geunsan province. It flows to the west and penetrates a very densely populated downtown area. It consists of a Province Grade I Stream(with a stream channel length of 26.29 ㎞, a total stream length of 7.7 ㎞, and a basin area of 89.31 ㎢) at the upper stream of Okgyegyo(bridge), Okgye-dong, Jung-gu, and a Province Grade II Stream (with a stream channel length of 18.59 ㎞, a total stream length of 14.7 ㎞, and a basin area of 49.14 ㎢) at the lower stream(Cho, 2006). Although a natural recreational forest and well-preserved woods are located at the upper stream area, there is some concern that the lower stream will be contaminated by waste water from households and that the forest will be damaged by the growing of rice and other crops. From the midstream to the lower stream areas, a monotonous ecosystem is expected due to heavy contamination by artificial structures and a uniformed natural landscape such as densely built houses, factories, riverbed roads, bicycle roads and grassy fields. The Yudeung stream, which belongs to the Geum River system, is the second tributary of the Geum River and the first tributary of the Gap stream. It originates at Mt. Indae located in Samga-ri, Jinsan township in Geumsan province and at the base of Mt. Wolbong. It flows to the north, merges with a tributary stream to the west at Jinsan township and

to the east at Boksoo township, and then merges with the Jibang stream to the east, after which it flows into Daejeon city. The 15.5 ㎞ zone from the neighborhood of Chimsan-dong, Jung-gu(Central district) to the merging point with the Gap stream is national land. The water quality of the upper area stream of the Yudeung stream is good, and it is used as a recreation area. It is an ecologically good stream where many types of fish can be found. At the lower stream area, there are artificial facilities such as houses, riverbed roads, bicycle roads and sports facilities, similar to the Daejeon stream. The purpose of this study was to identify differences in the community structure of the terrestrial insects living at the streamside of the Daejeon stream and the Yudeung stream and the ecological differences between the natural stream and artificial stream environments. The results of this study can be used as basic materials for long-term monitoring and to identify problems and create solutions during streamside improvement projects

MATERIALS AND METHODS

1. Survey areas

The Daejeon stream was divided into 6 zones from Mt. Manin(its origin) to the point where it merges into the Yudeung stream. These zones include two areas that were classified as urban stream areas. The Yudeung stream was

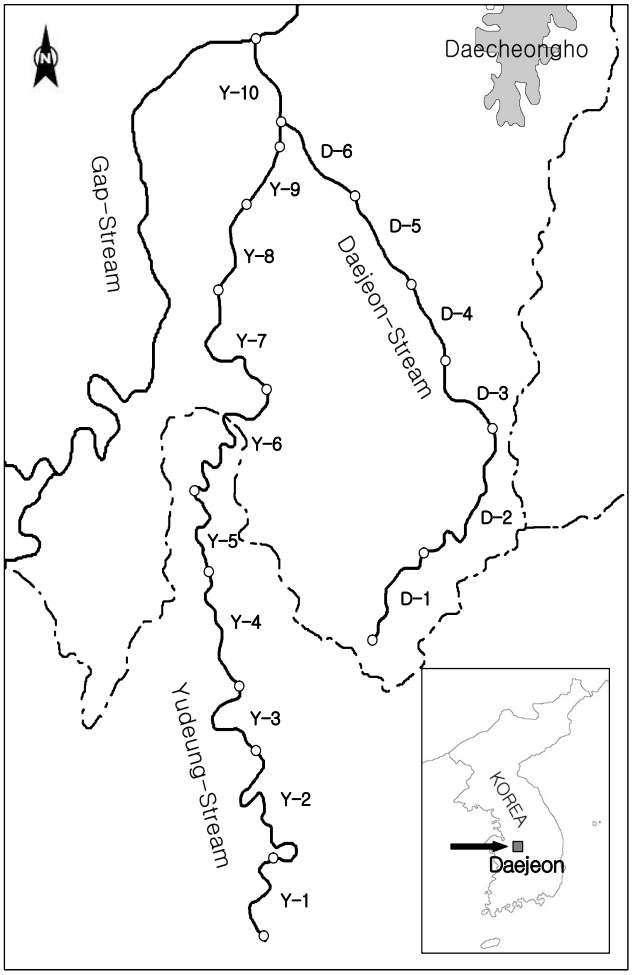


Figure 1. Map of survey areas

Table 1. Survey areas at the Daejeon and Yudeung streamsides

Site	Survey areas
D-1	Haso-dong, Dong-gu, Daejeon (N 35° 11′ 59.05″, E 127° 26′ 45.08″)
D-2	Sangso-dong, Dong-gu, Daejeon (N 36° 13′ 36.04″, E 127° 27′ 23.04″)
D-3	Gudo-dong, Dong-gu, Daejeon (N 36° 15′ 30.05″, E 127° 29′ 02.04″)
D-4	Daebyul-dong, Dong-gu, Daejeon (N 36° 17′ 03.03″, E 127° 27′ 53.07″)
D-5	Hyo-dong, Dong-gu, Daejeon (N 36° 18′ 15.04 , E 127° 27′ 01.08″)
D-6	Jung-dong, Dong-gu, Daejeon (N 36° 19′ 29.04″, E 127° 25′ 57.08″)
Y-1	Samga-ri, Jinsan-myeon, Geumsan-gun, Chungnam (N 36° 07′ 37.01″, E 127° 23′ 43.01″)
Y-2	Buan-ri, Jinsan-myeon, Geumsan-gun, Chungnam (N 36° 08′ 36.05″, E 127° 23′ 54.04″)
Y-3	Suyoung-ri, Boksoo-myeon, Geumsan-gun, Chungnam (N 36° 10′ 09.05″, E 127° 23′ 39.02″)
Y-4	Gurye-ri, Boksoo-myeon, Geumsan-gun, Chungnam (N 36° 11′ 39.07″, E 127° 23′ 17.05″)
Y-5	Sindae-ri, Boksoo-myeon, Geumsan-gun, Chungnam (N 36° 13′ 12.00″, E 127° 22′ 49.01″)
Y-6	Jiryang-ri, Boksoo-myeon, Geumsan-gun, Chungnam (N 36° 14′ 38.04″, E 127° 22′ 27.03″)
Y-7	Chimsan-dong, Dong-gu, Daejeon (N 36° 15′ 58.09″, E 127° 23′ 50.00″)
Y-8	Boksoo-dong, Seo-gu, Daejeon (N 36° 17′ 47.04″, E 127° 23′ 10.02″)
Y-9	Taepyeong-dong, Jung-gu, Daejeon (N 36° 19′ 14.04″, E 127° 23′ 21.05″)
Y-10	Samcheon-dong, Seo-gu, Daejeon (N 36° 21′ 04.03″, E 127° 24′ 17.05″)

divided into ten areas from its origin in Samga-ri, in Jinsan township, Geumsan province to the point at which it merges with the Gap stream. It included three areas that were classified as urban stream areas(Table 1, Figure 1).

2. Survey methods

For the purpose of this study, quantitative surveys were performed once a month from April to October of 2008. To investigate ground beetles, bait traps were used, while sweeping was used to investigate the insects perched on grass, shrubs or trees as well as those flying. Light traps were not used because they can attract nocturnal insects, the study of which is beyond the scope of the survey. Identification was made of the collections by the Animal Taxonomy and Ecology Laboratory at Daejeon University. Unidentified species were sent to experts in each taxonomy group for identification. An insect list was formulated based on the Checklist of Insects from Korea(1994). Diversity index was calculated using the Shannon-Weaver function (Pielou, 1969), which was influenced by the information theory of Margalef(1958). The similarity Index by Bray and Curtis(1957) was calculated regarding the number of species and the number of individuals at each point, and a weighted average combination method was used to build a dendrogram. To verify the differences between groups, a T-test was performed. Additionally, a Pearson analysis was executed to identify the correlations between the induced factors. For the statistical analysis, SPSS ver. 12K and Primer ver. 6 were used(Clarke and Gorley, 2006).

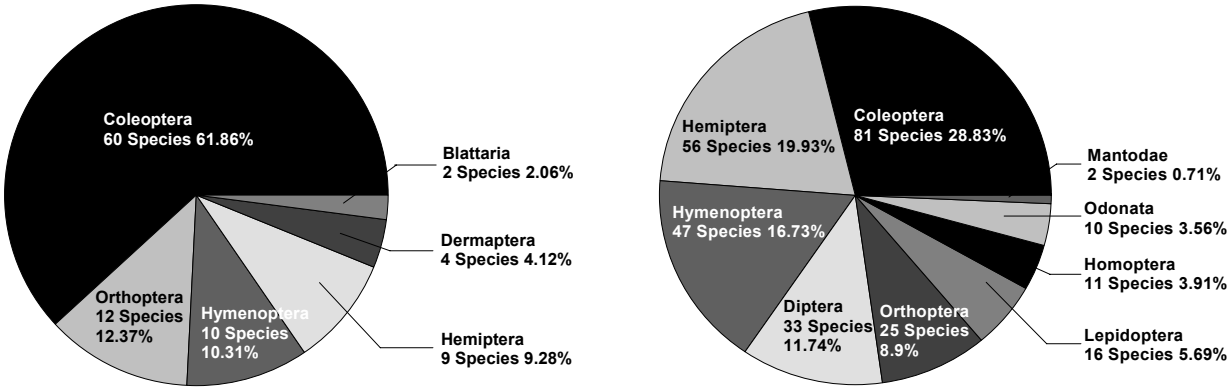
RESULTS AND DISCUSSION

1. Species composition

The insects identified at the Daejeon stream and the Yudeung stream belonged to 428 species, 110 families and 11 orders counted in total. At the Daejeon stream, 335 species, 99 families and 11 orders were identified. Coleoptera was the most commonly identified order, with 26 families and 114 species(34.03%), and the next most common orders were as follows: Hemiptera with 60 species and 16 families(17.91%), Hymenoptera with 51 species and 7 families(15.22%), Diptera with 33 species and 16 families (9.85%), Orthoptera with 32 species and 9 families(9.56%), Lepidoptera with 16 species and 8 families(4.78%), Homoptera with 11species and 7 families(3.28%), Odonata with 10 species and 5 families(2.99%), Dermaptera with 4 species and 3 families(1.19%), and Blattaria and Mantodea with 2 species and 1 family(0.6%) each(Table 2). The insects collected by bait traps belonged to 97 species, with 34 families and 6 orders. The most diverse order was Coleoptera, with 60 species and 18 families (61.86%). The order of diversity was Orthoptera with 12 species and 6 families(12.37%), followed by Hymenoptera with 10 species and 1 family(10.31%), Hemiptera with 9 species and 5 families(9.28%), Dermaptera with 4 species and 3 families(4.12%), and Blattaria with 2 species and 1 family(2.06%). The insects collected by sweeping belonged to 281 species, with 85 families and 9 orders. The most diverse order was Coleoptera with 81 species and 20

Table 2. Species composition by order at the Daejeon and Yedeung streamside areas

Order	Daejeon streamside			Yudeung streamside		
	Families	Species	%	Families	Species	%
Odonata	5	10	2.99	4	12	3.43
Blattaria	1	2	0.60	1	1	0.29
Mantodea	1	2	0.60	1	3	0.86
Dermaptera	3	4	1.19	1	1	0.29
Orthoptera	9	32	9.56	9	33	9.43
Hemiptera	16	60	17.91	17	61	17.43
Homoptera	7	11	3.28	9	16	4.57
Coleoptera	26	114	34.03	25	113	32.29
Hymenoptera	7	51	15.22	7	47	13.43
Diptera	16	33	9.85	17	38	10.86
Lepidoptera	8	16	4.78	7	25	7.14
11 Orders	99	335	100.00	98	350	100.00

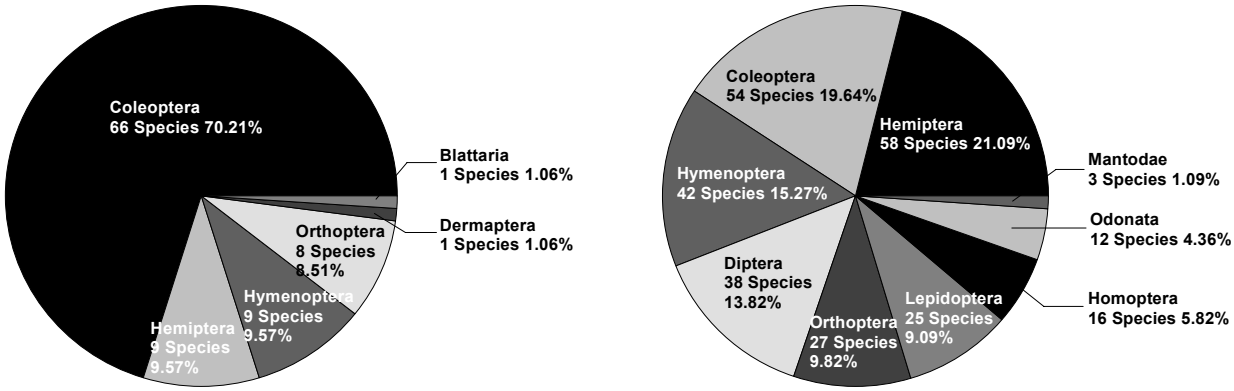


Bait trap Sweeping

Figure 2. Composition of the species collected at the Daejeon streamside area

families(28.83%), and the next most diverse orders were Hemiptera with 56 species and 14 families(19.93%), Hymenoptera with 47 species and 7 families(16.73%), Diptera with 33 species and 16 families(11.74%), Orthoptera with 25 species and 7 families(8.9%), Lepidoptera with 16 species and 8 families(5.69%), Homoptera with 11 species and 7 families(3.91%), Odonata with 10 species and 5 families(3.56%), and Mantodea with 2 species and 1 family(0.71%)(Figure 2).

At the Yudeung stream, 350 species, 98 families and 11 orders were identified. Out of them, Coleoptera was the highest, with 113 species and 25 families(32.29%), and the next most common orders were Hemiptera with 61 species and 17 families (17.43%), Hymenoptera with 47 species and 7 families(13.43%), Diptera with 38 species and 17 families(10.86%), Orthoptera with 33 species and 9 families(9.43%), Lepidoptera with 25 species and 7 families(7.14%), Homoptera with 16 species and 9 families (4.57%), Odonata with 12 species and 4 families(3.43%), and Mantodea with 3 species and 1 family(0.86%). The least common orders were Blattaria and Dermaptera with 1 species and 1 family(0.29%)(Table 2). The insects collected by bait traps belonged to 94 species, 29 families and 6 orders. The most diversely identified order was Coleoptera with 66 species and 18 families(70.21%), followed by Hemiptera with 9 species and 5 families(9.57%), Hymenoptera with 9 species and 1 family(9.57%), Orthoptera with 8 species and 4 families(8.51%), and Dermaptera and Blattaria with 1 species and 1 family each(1.06%). The insects collected by sweeping contained 275 species, with 81 families and 9 orders. Out of them, Hemiptera was the most diversely identified order, with 58 species and 15



Bait trap Sweeping

Figure 3. Composition of the species collected at the Yudeung streamside area

families(21.09%), followed by Coleoptera with 54 species and 1 family(19.64%), Hymenoptera with 42 species and 7 families(15.27%), Diptera with 38 species and 17 families(13.82%), Orthoptera with 27 species and 7 families(9.82%), Lepidoptera with 25 species and 7 families(9.09%), Homoptera with 16 species and 9 families(5.82%), Odonata with 12 species and 4 families(4.36%), and Mantodea with 3 species and 1 family(1.09%) in that order(Figure 3).

Before this study, terrestrial insects at streamside locations were investigated twice. Jung and Yeo(1996) reported 176 species and 199 species at the Changwon stream and at the Nam stream in Changwon city, respectively, and Bae et al.(2002) reported 316 species at the Choyang river and Dong river, which are located respectively in Pyeongchang province and Jeongseon province. Although these studies investigated different areas and at different times compared to this study, Coleoptera was the most diverse order in all of the studies, demonstrating that Coleoptera is a very common order at streamside locations. In particular, Cerambycidae was found to habituate in damp and dark areas under rocks or in trees, whereas Chrysomelidae habituated in wide grass fields at stream side locations, accounting for the high density. Moreover, Hymenoptera and Hemiptera were found to be more common than other types of insects. Fewer species in Lepidoptera were identified because this survey did not use light traps.

2. Community analysis according to the survey areas

At the Daejeon stream, 178 species, 72 families and 11 orders were collected at the D-1 point; 178 species, 66 families and 11 orders at D-2; 157 species, 53 families and 8 orders at D-3; 146 species, 57 families and 10 orders at D-4; 159 species, 62 families and 9 orders at D-5 point; and 143 species, 58 families and 9 orders at D-6(Table 3). At D-1 and D-2, the most species were identified, at 178 species, while D-6 was the point at which the lowest number of species was identified. This may have arisen because the D-1 and D-2 areas encompass wide forest areas, including the neighboring Mt. Manin, and are far from urban areas, although they have narrow streams and an unstable habitat owing to stream straightening efforts and unclear banks. D-6, showing the lowest number of insect species, passes an urban area, and the water quality worsens as the Daedong stream merges into it near Hyeonamgyo(bridge)(Kim and Seo, 1994). Additionally, people travel through this area quite often on account of the presence of riverbed roads and parking lots, and most of the area is covered with grassy fields. Those factors as a whole may cause the low density of insects. At the Yudeung stream, 160 species, 61 families and 11 orders were identified, at Y-1; 179 species, 65 families and 9 orders at Y-2; 144 species, 51 families and 9 orders at Y-3; 118 species, 53 families and 9 orders at Y-4; 167 species, 65 families and 10 orders at Y-5; 145 species, 54 families and 10 orders at Y-6; 142 species, 59 families and 10 orders at Y-7; 102 species, 48 families and 9 orders at Y-8; 116 species, 52 families and 9 orders at Y-9; and 108 species, 51 families and 9 orders at Y-10(Table 3). Y-2 showed the most species, at 179, and Y-8 showed the fewest species, at 102. Y-2, with the most species, has a wide stream area and excellent quality forest to create

Table 3. Species composition by survey area at the Daejeon and Yudeung streamside areas

Site	Daejeon streamside				Site	Yudeung streamside			
	Orders	Families	Species	Individuals		Orders	Families	Species	Individuals
D-1	11	72	178	1,286	Y-1	11	61	160	1,656
D-2	11	66	178	2,191	Y-2	9	65	179	1,660
D-3	8	53	157	1,401	Y-3	9	51	144	1,660
D-4	10	57	146	1,649	Y-4	9	53	118	1,468
D-5	9	62	159	1,617	Y-5	10	65	167	1,248
D-6	9	58	143	1,860	Y-6	10	54	145	1,414
					Y-7	10	59	142	1,701
					Y-8	9	48	102	1,757
					Y-9	9	52	116	2,539
					Y-10	9	51	108	1,575

diverse habitats for insects. Fewer people travel through this area, allowing this area to have the characteristics of a natural stream. Y-8, with the fewest species has large apartment blocks near the site. At the streamside of Y-8, a grassy field is situated owing to a river improvement project, and there are bicycle and walking paths near this point. Therefore, insect habitats are mostly destroyed owing to the work done to the stream and the banks, mainly for the people who come to rest or exercise there. DGN(the Degree of Green Naturality) is influenced by tire contaminants flowing from riverbed roads, by streamside temperature increases due to the use of concrete blocks, and by dryness owing to the stream straightening project. To resolve these issues, artificial facilities such as riverbed roads and parking lots should be removed in phases and plant communities should be composed to restore it as a close-to-nature stream(Park *et al*., 2002).

From a community analysis at each investigation point, the diversity index was the highest at Y-5 and D-1, at 3.945 and 3.881, respectively, and lowest at Y-9 and Y-8, at 2.106 and 2.845, respectively. The species richness index was the highest at D-1 and Y-2, at 27.723 and 24.007, and lowest at Y-8 and Y-10, respectively at 13.518 and 14.534(Figure 4). In particular, Y-8, Y-9 and Y-10, which are located at the lower stream of the Yudeung stream, showed a remarkably lower species richness index compared to other points at the Daejeon stream and Yudeung stream. The main problems identified were related to the straightening of the water reservoir, the steady and constant width of the stream, the destruction of vegetation to build riverbed roads, the induction of contaminants from parking lots, a lowered water flow speed on account of the constant water depth caused by the artificial reservoir composition, and the removal of the aquatic plant habitat as a result of the riverbed arrangement (Park *et al*., 2002).

The dominance index was highest at Y-9 and Y-7, at 0.650 and 0.514, respectively, and it was lowest at D-1 and Y-5, at 0.304 and 0.228. The evenness index was highest at Y-5 and D-1, at 0.771 and 0.749, respectively, and lowest at Y-9 and Y-7, at 0.443 and 0.584. Y-9 and Y-7 with the highest dominance index had 1,559 and 753 individuals of Tetramorium caespitum, which is the dominant species, which increased the dominance index. On the other hand, those points showed the lowest

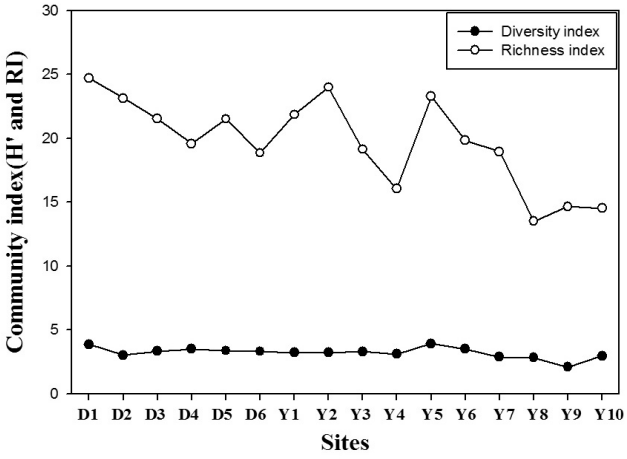


Figure 4. Comparison of diversity and richness indices

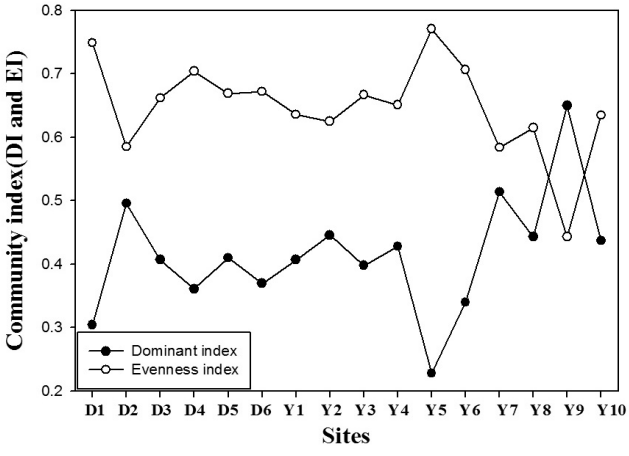


Figure 5. Comparison of dominance and evenness indices

evenness index owing to the high proportion of the dominant species. At Y-5, the number of individuals of T. caespitum was 173, which is the lowest among the 16 investigation points. Consequently, it showed the highest evenness index and the lowest dominance index at the same time(Figure 5).

3. Similarity analysis

From the analysis of the similarity index of each investigation point, D-5 and D-6 showed the highest degree of similarity, at 60.66%, for the Daejeon stream, which means they have similar habituating environments. These points are situated from the neighbrohood of Hyo-dong, Daejeon city, to the neighborhood of Jung-dong, where convenience facilities for citizens are located,

grassy fields are planted, and weed-removal projects are performed seasonally. At the Yudeung stream, Y-2 and Y-3 and Y-3 and Y-4 showed the highest degree of similarity, at 61.28%, and the next most similar areas were Y-9 and Y-10, with a similarity ratio of 61.44%. Among them, the Y-2, Y-3, and Y-4 areas are well-preserved areas of the upper part of the Yudeung stream, and the Y-9 and Y-10 areas in the lower area show characteristics similar to the Daejeon stream due to the heavy traffic on the riverbed road and the artificial planting of the grassy fields(Table 4).

From the cluster analysis based on the similarity index, the investigation points were classified into three groups: A-1, A-2 and B. The A-1 group included D-1, D-2, D-3 and D-4, covering the upper and midstream areas of the Daejeon stream from its origin to the urban stream area in

Table 4. Similarity index between sampling sites at the Daejeon and Yudeung streamside areas

	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
D-1	100															
D-2	57.31	100														
D-3	52.85	52.74	100													
D-4	51.40	55.12	53.39	100												
D-5	52.94	51.09	51.39	57.61	100											
D-6	48.76	45.80	49.17	51.06	60.66	100										
Y-1	50.99	50.51	49.16	46.12	48.03	46.16	100									
Y-2	53.06	50.17	51.05	47.11	52.10	49.71	56.87	100								
Y-3	50.83	53.07	52.31	51.00	56.32	52.59	54.76	61.28	100							
Y-4	50.26	44.31	45.68	44.28	49.40	47.04	52.77	57.11	61.28	100						
Y-5	50.86	46.55	46.46	44.19	49.18	45.76	54.39	55.88	55.49	54.65	100					
Y-6	53.60	50.58	49.88	44.99	48.17	46.51	53.75	56.99	60.44	56.35	56.05	100				
Y-7	52.27	50.69	51.34	49.92	51.65	47.97	57.32	58.56	58.39	51.77	52.92	57.86	100			
Y-8	42.06	43.08	38.06	57.52	55.38	54.85	45.23	44.82	47.22	46.50	44.17	44.63	46.94	100		
Y-9	42.81	45.69	37.07	46.30	54.30	53.24	42.76	52.42	51.12	49.89	45.26	47.72	51.65	60.50	100	
Y-10	41.47	42.23	40.82	49.33	54.45	55.74	49.49	49.78	53.63	52.47	47.81	48.68	51.44	58.71	61.44	100

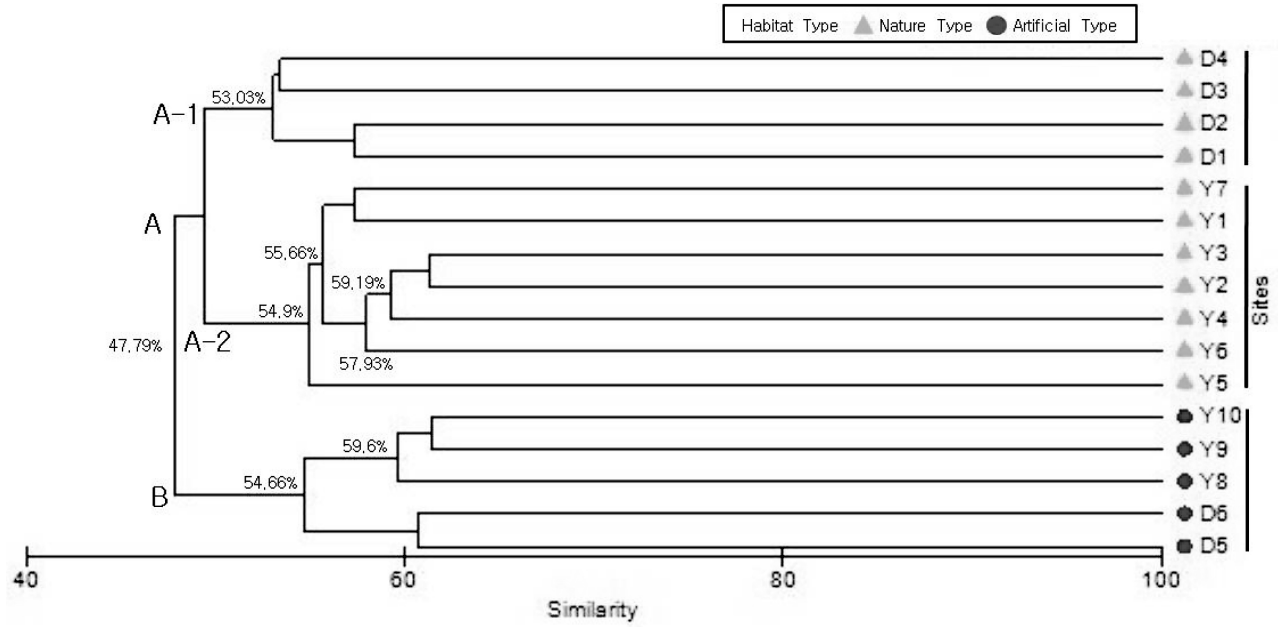


Figure 6. Cluster analysis based on insects collected from 16 sites at the Daejeon and Yudeung streamside areas

Table 5. T-test and correlation analysis for habitat types and community indices

Community indexes	Statistics			
	T-test		Correlation analysis	
	F	P-value	r	P-value
Number of species	7.190*	0.018	-0.582*	0.018
Dominant index	1.946	0.185	0.349	0.185
Diversity index	4.258	0.058	-0.483	0.058
Evenness index	2.413	0.143	-0.383	0.143
Richness index	8.411*	0.012	-0.613*	0.012

*P<0.05 in the Person correlation analysis

Daebyeol-dong. The A-2 group included Y-1, Y-2, Y-3, Y-4, Y-5, Y-6 and Y-7, covering the upper and midstream parts of the Yudeung stream from its origin to the urban stream in the Chimsan-dong neighborhood. Te B group included D-5, D-6, Y-8, Y-9 and Y-10, covering the lower parts of both the Daejeon stream and the Yudeung stream which pass through urban areas. Through a comparison of the three groups, the differences in the insect habitats and species diversity according to the natural streamside environments could be identified. Although A-1 and A-2 had similar natural environments, they showed different emergences of insects as a result of their regional differences, as the Daejeon stream and the Yudeung stream had different diversity and richness characteristics in terms of the insect species habituating in the streamside areas. The B group had the typical natural environment of an urban stream, passing Daejeon city, which showed the influence of stream and streamside management on the insect habitats (Figure 6). Although stream naturality is reflected in the streamside management plan, most of these efforts were based on physical factors such as the physical structure and water quality analysis. Therefore, continuous studies regarding evaluation indexes of the physical structure and biological, geological and geographical characteristics and a method to integrate them are necessary(Pyo and Mun, 2011).

When a T-test was executed to verify the differences in the averages of the groups classified by the cluster analysis, it satisfied the normality and homoscedasticity measures, though a statistical difference was noted in the number of species(P=0.018) and the species richness index(P=0.012). In the correlation analysis to identify the relationship between the number of species and the habitat type, it was found that both the number of species ($r=-0.582$, $p<0.05$) and the species richness($r=-0.613$, $p<0.05$) showed a negative correlation(Table 5). Thus, streamside habitats were found to provide diverse habitats for living things, and the straightening of the streamside influenced the number of species and the richness of the insect community, as in earlier studies(Vannote *et al*., 1980).

From the results of this study, the characteristics of streamside insect communities were identified and changes in the ecology after river improvement efforts were confirmed. This can provide a model of the species diversity changes in the stream ecosystems through the identification of the relationships between terrestrial insects habituating at streamside areas and benthic macro-invertebrate insects habituating in the stream.

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Appendix 1. List of insect species collected at the Daejeon and Yudeung streamsides

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Order Odonata																
Ischnura asiatica (Brauer)	2	2	1		5	2	2	3	9	6		1	2	2	3	1
Cercion hieroglyphicum (Brauer)	4	1	1		2			1	4	4		4				
Cercion calamorum calamorum (Ris)	3		1		4			7	9	1	2	2	6		1	1
Copera annulata (Selys)								1		1						
Platycnemis phillopoda Djakonov	7	1		5				9		1			4			
Calopteryx atrata Selys	1	4	1					1								
Orthetrum albistylum speciosum (Uhler)							1		2	3		2				1
Pantala flavescens (Fabricius)							1	1								
Lyriothemis pachygastra (Selys)											1					
Calopteryx japonica Selys	1	6	1		3											
Ictinogomphus clavatus (Fabricius)					1											
Sympetrum infuscatum (Selys)	2						1									
Sympetrum depressiusculum (Selys)	4	4	2				1	2								
Sympetrum pedemontanum elatum (Selys)	22	5	3		1		1	1	2	3	1					
Order Blattaria																
Blattella germanica (Linné)	1	1		5												
Blattella nipponica Asahina				1			2									
Order Mantodea																
Statilia maculata (Thunberg)											1	1				
Tenodera angustipennis Saussure	1						1				1					
Tenodera aridifolia (Stoll)		1					1						1			
Order Dermaptera																
Anisolabis maritima (Bonelli)	10	1		1		5										
Gonolabis marginalis (Dohrn)	2				1											
Labidura riparia japonica (de Haan)	7	7			13	19	1	9	21	12	17	20	10	53	53	77
Anechura japonica (Bormans)						7										
Order Orthoptera																
Diestrammena apicalis Brunner								1			1					
Tachycines uenoi Yamasaki	1												3			
Diestrammena japonica Karny	7															
Ruspolia lineosa (Walker)							1									2
Ducetia japonica (Thunberg)		1								2						
Metrioptera (Metrioptera) bonneti (Bolivar)													1			
Gampsocleis sedakovi abscura Walker	3		1	1								1		1		
Tettigonia viridissima (Linné)	1	1			3		1						1			
Elimaea grandis (Matsumura et Shiraki)									1							

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Phaneroptera falcata (Poda)	1		4	4	4	1	1	2	2		1		2			6
Phaneroptera nigroantennata Brunner		1		1	3			2	4	3	4		5		3	2
Hexacentrus unicolor Serville	1	2	2		3	1					1					
Conocephalus chinensis (Redtenbacher)	1	2	1	2	9	1										
Conocephalus gladiatus (Redtenbacher)		1		1												
Oecanthus indicus Saussure		22			1		3				1				2	1
Velarifictorus aspersus (Walker)	7	9		14		1	21	29	15	4	16	11	16		7	8
Loxoblemmus arietulus Saussure	6	5	3	2	1		1					3				
Teleogryllus emma (Ohmachi et Matsumura)	8	3						3			3	5	6		4	
Dianemobius furumagiensis (Ohmachi et Furukawa)														7		
Dianemobius nigrofasciatus (Matsumura)	7			7	14	4		3	4	8	3	4	3		7	1
Homoeogryllus japonicus (de Haan)			1													
Atractomorpha lata (Motschulsky)	45	33	10	31	10	7	12	7	3	3	2	19	13	17	28	6
Anapodisma beybienkoi Rentz et Miller							1									
Xya japonica (de Haan)	1							32				1				
Gryllotalpa orientalis (Burmeister)	1				1			1		2					1	
Criotettix japonicus (de Haan)	3	7		1	1		2	3		2	1	2			1	
Tetrix japonica (Bolivar)	5	13	5	27	16	10	4	39	18	2	13	7	9	1	32	6
Acrida cinerea cinerea (Thunberg)	6	2	1	30	16	16	3	4				4		33	17	13
Oxya japonica japonica (Thunberg)	14	8	5	9	7	1	21	22	10	3	1	29	15	2	2	4
Shirakiacris shirakii (Bolivar)		6	9	4	2		3	3				2				
Catantops splendens Thunberg		1					2									
Arcyptera fusca albogeniculata Ikonnikov	1	2	3		1				4		1	3	3		2	1
Podismopsis (Podismopsis) genicularibus (Shiraki)			1													
Mecostethus alliaceus alliaceus (Germar)		7	2					1								
Stethophyma magister (Rehn)			1			1	7	1					1			2
Gastrimargus marmoratus (Thunberg)			1								2		2			
Oedaleus infernalis Saussure			2	3				4			1					
Trilophidia annulata Thunberg					1	1						1	1			
Order Hemiptera																
Nepa hoffmanni Esaki	2	4								1						
Orius(Dinorphella) sauteri (Poppius)								1		1			1	4	23	
Saldula saltatoria (Linné)		2	3		1		1				2	19	2			
Nabis (Nabis) stenoferus Hsiao	2	19	2	12	11	45		4	9	3	10	2	5	5	5	19
Monalocoris filicis (Linné)	6	2	6	1	2		10	9		4	1	11	7	1		
Halticiellus insularis (Usinger)	3	2	3			7	4	6	1		8	5	5			
Adelphocoris suturalis (Jakovlev)		3	2	12	6	6	1	4	4	3	12	1	17		6	7

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Lygocoris (Apolygus) hilaris (Horváth)									2			2				
Adelphocoris triannulatus (Stal)	4	3	2				18	5			4	6	3			
Stenodema (Brachystira) calcarata (Fallén)	1	14	2	41	13	5	9		4	3	13	24	16	3	4	3
Taylorilygus apicalis (Fieber)	22	7	12	7	9		1	6	14	14	9	7	1	2	3	1
Proboscidocoris varicornis (Jakovlev)												1				
Charagochilus angusticollis Linnavuori	8	15	8	5	1		14	5	1	5	3	7	24			
Creontiades pallidifer (Walker)		1	3	95	41	25		8	10	1		4		59	24	44
Eurystylus coelestialium (Kirkaldy)	2	3	1		2		6		1				1			
Stenodema (Stenodema) rubrinervis Horváth		3		4			1									
Stenodema (Stenodema) sibirica Bergroth	1			8	1											
Trigonotylus coelestialium (Kirkaldy)	2	8	7	59	61	102	3	5	20	2	3		7	112	91	60
Miridae sp.1	2	2	11	6	6		37	15	27		36	25	37			
Dicyphus miyamotoi Yasunaga							1							1		
Cydnocoris russatus Stal							1									
Peirates (Cleptocoris) turpis Walker		1														
Sphedanolestes impressicollis (Stal)			1													
Metatropis tesongsanicus Josifov										2	9					
Yemma exilis Horváth	1		2		1	23	1	1		2	2		1		1	3
Chauliops fallax Scott			2					1					1			
Arocatus melanostoma Scott									1							
Paraparomius lateralis (Scott)							1	1	1			1	1	1	1	11
Dimorphopterus pallipes (Distant)		1	1	2	2	1	7	5	1		2	2	15		7	1
Geocoris (Geocoris) pallidipennis (Costa)		1			1	1										
Geocoris (Geocrois) proteus Distant	9	49	4	26	21	52	1	6	6		3	6	1	66	41	55
Geocoris (Piocoris) varius (Uhler)		1			1			1							1	
Arocatus sericans Stal		1														
Lygaeus hanseni Jakovlev						1	3	2			2		1	4	1	
Pachygrontha antennata (Uhler)	14	16	6	7	5	18	2	6	9	10	8	1	12	6	7	2
Togo hemipterus (Scott)	5		2	2	4						1					1
Nysius (Nysius) plebejus Distant	48	88	39	155	63	86	88	28	75	18	14	28	102	77	46	108
Panaorus albomaculatus (Scott)	5	2		2	1	1					1			1		2
Pyrrhocoris sibiricus Kuschakewitsch	1	1	8	16		1	3	1		3	1					
Geotomus pygmaeus (Dallas)		2				1										1
Aethus nigrita (Fabricius)												1				
Macroscytus japonensis Scott		1														
Acanthocoris sordidus (Thunberg)	3	10	5	21				2								
Homoeocerus dilatatus Horváth		2														

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Hygia (Colpura) lativentris (Motschulsky)		17		5												
Hygia (Hygia) opaca (Uhler)		1						2								
Cletus schmidti Kiritshenko	3	35	17	5	8	8	5	12	6	11	9	7	6	6		4
Cletus punctiger (Dallas)	2	1				9		3	12	5	2	2		1		2
Riptortus clavatus (Thunberg)	1	7		1				3	1		1	3	2		5	
Liorhyssus hyalinus (Fabricius)	2	20	8	23	1	6		8	14	4	2		3	4	6	
Rhopalus (Aeschyntelus) maculatus (Fieber)	28	38	3	39	4	4	22	4	9	18	16	1	6	11	4	14
Rhopalus (Aeschyntelus) sapporensis (Matsumura)	34	40	5	17	9	8	17	18	25	15	4	2	9	18	1	1
Stictopleurus crassicornis (Linné)	4	1			1				1		1					
Coptosoma parvipictum Montandon							1				5					
Coptosoma bifarium Montandon	2	14						1	1		1					
Megacopta punctatissima (Montandon)	2	2					1									
Eurygaster testudinaria (Geoffroy)		3		7							1					
Aelia fieberi Scott	1	3	3	11	1	3		1	1	17	1	1	18	2	1	
Piezodorus hybneri (Gmelin)															3	
Carbula putoni (Jakovlev)	1						7				1					
Dolycoris baccarum (Linné)	3	3	3	2	3	4	1	1	3	2	4	3	3			
Eurydema gebleri Kolenati		7	45	11		51	59	36	50	66	7	15	1		7	14
Eurydema rugosa Motschulsky						1										
Nezara antennata Scott	1		4	4	19	3		2	1	1	1		1			
Eysarcoris guttiger (Thunberg)															1	
Eysarcoris ventralis (Westwood)	1	1	2	12	14			2		3	1	1		1	1	5
Eysarcoris aeneus (Scopoli)		2			1		4		1		5	2				1
Eysarcoris lewisi (Distant)		1							1	1	1	1		1		
Halyomorpha halys (Stal)						1										
Menida violacea Motschulsky	1															
Rubiconia intermedia (Wolff)			2	1	2											
Scotinophara horvathi Distant										1						
Dybowskyia reticulata (Dallas)		2	1								1					
Order Homoptera																
Lepyronia coleoptrata (Linné)																2
Eoscartopsis assimilis (Uhler)								1								
Aphrophora major Uhler	1				2		10	3	1	22	2		5			
Machaerotypus sibiricus (Lethierry)	2	1										1				
Euricania clara Kato															1	
Nephotettix cincticeps (Uhler)	1		2	2		1		1	1	3		1			3	
Cicadella viridis (Linné)	57	3	3	12		2	2	5	5			2	4	2	5	7

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Bothrogonia japonica Ishihara	2	1					14	1			2					
Recilia (Inazuma) dorsalis (Motschulsky)						1						1				
Orosanga japonica (Melichar)				2	1											
Ricania taeniata Stal						1									1	
Diostrombus politus Uhler	2		41				3	2			6					2
Orthopagus lunulifer Uhler												1				
Pentastiridius apicalis (Uhler)										2	2	1	1			
Kuvera ligustri Matsumura				3			1									
Stenocranus matsumurai Metcalf	16	2	9		1	1	87	11	21	17	109	22	25	1	1	1
Terauchiana nigripennis Kato							1						1			
Hemicarabus (Hemicarabus) tuberculosus (Dejean et Boisduval)		2					1									
Nebria (Paranebria) livida angulata Bänninger								2	2	2	1		12			
Elaphrus (Elaphrus) comatus Goulet												1				
Nebria (Orientonebria) chinensis chinensis Bates	2				1		15	15	4	14	4	33	7			14
Patrobus flavipes Motschulsky					2	1			6			2				
Bembidion (Trichoplataphus) lissonotum Bates		1														
Bembidion (Peryphus) scopulinum (Kirby)								1								
Bembidion (Peryphus) semilunium muchei Jedlicka							1	4	1							
Harpalus (Cephalomorphus) capito Morawitz									1							
Bradycellus (Lioholus) laeticolor Bates												1				
Bembidion (Peryphus) morawitzi Csiki		1		1		162	6	24			2	1				
Tachyura gradata (Bates)			6				16	42	2	4	1	4				1
Colpodes (Eucolpodes) japonicus (Motschulsky)		1			2			1	4	2	1	5			2	
Pterostichus (Rhagadus) microcephalus (Motschulsky)	1										39	6				
Synuchus (Synuchus) melantho (Bates)					1											
Dolichus halensis (Schaller)	3	5			18	6	1	3	20	26	27	3	1	19	83	127
Synuchus (Crepidactyla) nitidus Motschulsky		2														
Synuchus (Synuchus) cycloderus (Bates)				1		3								1		1
Anisodactylus punctatipennis Morawitz	3		2		7	2	2	7		1	44	1	1	5	4	2
Anisodactylus signatus (Panzer)	2			2			1				22			3		
Amara (Amara) obscuripes Bates														1		
Amara (Curtonotus) gigantea (Motschulsky)	2						1			1						
Harpalus (Harpalus) bungii Chaudoir					1											
Harpalus (Pseudoophonus) davidi Tschitschérine			1		1	4	1	14	4	6	13	4			3	26
Harpalus (Pseudoophonus) coreanus (Tschitschérine)		2	1	2		2			1					1		
Harpalus (Paeudoophonus) Pseudophonoides Schanberger	1	3	2	2										3		
Harpalus (Harpalus) chalcentus Bates			1		2						1			1		

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Amara (Amara) congrua Morawitz			1						2		2					
Bradycellus subditus Lewsi				2												
Chlaenius (Chinelaus) pallipes Gebler	3	7	10					1	3						2	
Chlaenius (Pachydinodes) virgulifer Chaudoir	1		3									2				
Chlaenius (Ilaenchus) naeviger Morawitz	1			2	1					3		5	8			
Chlaenius (Chlaeniellus) ocreatus Bates	6	15	2			1	17	13	38	57	7	61	10	3	14	5
Chlaenius (Ilaenchus) posticalis Motschulsky	2															
Chlaenius (Chlaeniellus) inops Chaudoir	2	3				1	3	5	11	35	2	18		2	8	
Apristus striatus Motschulsky	8		8			8	3	10	6	7	16	21	19		1	1
Macrochlaenites costiger (Chaudoir)			2						1							
Odacantha aegrota (Bates)				2				1	1			1				
Scarites (Parallelomorphus) acutidens Cahudoir															2	
Cerambycidae sp.1	1			1						21	1			1		5
Cerambycidae sp.2	2		1				2	4								
Cerambycidae sp.3	1	2	5				4		5							
Cerambycidae sp.4									1							
Cerambycidae sp.5								3			6					
Cerambycidae sp.6	1	2			1	2		5	2		2					
Pterostichinae sp.1		1						2	1		1					
Pheropsophus jessoensis Morawitz					1	2		1			1				1	1
Eusilpha (Eusilpha) jakowlewi jakowlewi (Semenov)	1	2														
Silpha perforata perforata Gebler		6		3		1							2		1	1
Thanatophilus sinutatus (Fabricius)					1											
Psephidonus lestevoides (Sharp)								1								
Dianous banghaasi Bernhauer													2			
Stenus (Steus) comma Leconte	1															
Paederus (Paederus) parallelus Weise					1	3									1	
Ocypus (Xanthocypus) weisei Harold	1															
Platystethus japonucus Bernhauer					1											
Stenus sp.1		2			1		1									
Staphylininae sp.1				1				1								
Philonthini sp.1				1												
Anotylus sp.1		48	13	7			10				10		1			
Tachyporinae sp.1			1					1		1						
Quediini sp.1		1			2											
Onthophagus (Strandius) lenzii Harold											1					
Scarabaeidae sp.1													1	1		

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Anomala albopilosa Hope						2		1	1		1	1			1	
Anomala corpulenta Motschulsky			1													
Blitopertha orientalis (Waterhouse)						1							2			
Popillia quadriguttata quadriguttata (Fabricius)					3		1					1		1	3	2
Anomala chamaeleon Fairmaire								2				1				
Maladera cariniceps (Moser)								1		1				1	1	1
Heptophylla picea Motschulsky														1		
Rutelidae sp.1	2		1													
Ectinohoplia obducta (Motschulsky)	2															
Trichiorhyssemus asperulus (Waterhouse)				1	1	1							1	1		
Byrrhidae sp.1					1											
Cylindromorphini sp.1				1				1								
Enochrus (Holcophilydrus) simulans (Sharp)									1							
Chiagosinus vittiger (Heyden)								1								
Aeoloderma agnata (Candéze)		1				5						5				4
Elateridae sp.1	7	3	5	2		3	28	11	20	33	20	5	7			1
Elateridae sp.2			1													
Athemus vitellinus (Kiesenwetter)				1												
Malachius prolongatus Motschulsky	1	1	1	1					1		1		2			
Ussuripia hilleri (Reitter)		1			6	5										
Anadastus atriceps (Crotch)	1		3								1					
Ancylopus pictus asiaticus Strohecker	12	3		3	1		3	1	2	1	2	5	1	1		
Coccinella (Coccinella) ainu Lewis			1	2					3	8	10	5				
Vibidia duodecimguttata (Poda)		1														
Hippodamia (Hippodamia) tredecimpunctata (Linné)					6	5	1	6	20	1			2	4	1	6
Propylea japonica (Thunberg)	36	60	22	25	19	26	17	4	15	12	39	40	35	1	6	13
Harmonia axyridis (Pallas)	4	6	17	11	1		1	2	5			10	7			7
Oenopia bissexnotata (Mulsant)				2												
Hyperaspis amurensis Weise												1				
Coccinella (Coccinella) septempunctat Linné	3	1	39	26	12	6	6	13	2	3	8	3	11	6	18	5
Anthrenus museorum (Linné)															1	
Lathridiidae sp.1		1	2	12	10	8	8	2	19	18		4				32
Mordellidae sp.1	3	1	3	4	1											
Mordellidae sp.2				2												
Stricticomus valgipes (Marseul)	6	4	6	1		1	1	2		3	3	7	1	1		1
Anthicidae sp.1		2		1	2											
Anthicidae sp.2							1		1							

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Lytta caraganae Pallas		4														
Tenebrionidae sp.1				3			99				5	1	1		1	6
Chlorophorus japonicus (Chevrolat)																1
Anoplophora malasiaca (Thomson)												1				
Phytoecia rufiventris Gautier				1												
Agapanthia pilicornis (Fabricius)	1															
Lema (Petauristes) honorata Baly												1				
Medythia nigrobilineata (Motschulsky)													1			2
Lema (Lema) concinnipennis Baly	1		4		10	1	2	4	4	1		4				
Lema (Lema) diversa Baly			4	2							1			4		
Physosmaragdina nigrifrons (Hope)			3			1	1									
Basilepta fulvipes (Motschulsky)	22	4	5	2	9	6	2	3	1	1	8	22	11	4	12	3
Chrysolina virgata (Motschulsky)				1												
Monolepta quadriguttata (Motschulsky)	12		1	8	43	25	7	42	36	61	42	40	15	79	19	53
Paridea (Paraulaca) angulicollis (Motschulsky)						1										
Dactylispa angulosa (Solsky)	2		2	1	1			2					8			
Cassida (Cassida) lineola Creutzer									1							
Cassida (Cassida) nebulosa Linné	1		111		41	386										
Cassida (Cassida) rubiginosa Muller			1													
Thlaspida cribrosa (Boheman)	1															
Ophraella communa LeSage	3	2	40	39	9			1	8		2	8	122			
Cryptocephalus japanus Weise								1								
Pagria signata (Motschulsky)	1		4	3	6								4	10		
Chrysochus chinensis Baly				1		1								4		
Chrysomela (Chrysomela) populi Linné		1														
Gastrophysa atrocyanea Motschulsky						1		1			7					1
Plagiodera versicolora (Laicharting)		7	1	1	1	1	1		2	3	4		1	1	2	1
Galeruca extensa Motschulsky								1								
Chrysolina aurichalcea (Mannerheim)								1					1			
Galerucella grisescens (Joannis)	9	1	1	2			7	2		1	3	1		1	1	2
Aulacophora indica (Gmelin)		1	1					4	1	1	1	5	5	1	1	
Aulacophora nigripennis Motschulsky			2													
Agelasa nigriceps Motschulsky													1		4	
Agelastica coerulea Baly												1				1
Hemipyxis plagioderoides (Motschulsky)	1	4	2	2	3	4	1					1				
Chaetocnema (Chaetocnema) ingenua (Baly)	16	6	74		1	27	3	2	4	5	1	11	10	4	1	8
Longitarsus waterhorni Csiki	3	4					1		1				1		2	1

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Longitarsus succineus (Foudras)										2						
Luperomorpha pryeri (Baly)												1				
Phyllotreta striolata (Fabricius)								1			3	3		1		
Longitarsus nitidus Jacoby			1					2	1							
Luperomorpha xanthodera (Fairmaire)		2	2	2				2	1				1		1	
Cryptocephalus bilineatus (Linne)	1															
Callosobruchus chinensis (Linné)		1		1	4	14	2	1	1				1	8	7	28
Lixus imperessiventris Roelofs	1					1										
Apion (Pseudopiezotrachelus) collare Schilsky		2	2	2			3	1	5		1		2			3
Ceutorhynchus shaowuensis (Voss)	10	6					5	2	8		3	2	1	1		
Lixini sp.1	1		3			1	1		1		1	1				11
Order Hymenoptera																
Dolerus armillatus Konow					1	1	1						1	1		
Athalia japonica (Klug)						1										
Tenthredinidae sp.1						1	8	2	4		3	4	2	6	9	3
Braconidae sp.1	3		2	1	1	3			2		1				2	
Braconidae sp.2			4		5	1	2	2	6			1	7	1	2	1
Braconidae sp.3	6	10	3	6	5	4										
Braconidae sp.4	2	1	1		1	2										
Braconidae sp.5	1			1		3		1	1	1	1		3		1	4
Braconidae sp.6	1	2		2		2	1		1	2		1				
Braconidae sp.7		4	2						1	2			1			
Braconidae sp.8	1				1	1	3	2					1			1
Braconidae sp.9						1			1			1	1		2	
Braconidae sp.10		1	2			1		1	2							
Braconidae sp.11	1		11	1	13	20	1	1	1		3		1			
Braconidae sp.12								1			1	1	1			
Braconidae sp.13		1						1	2	1	2	1	6		1	
Trathala flavo-orbitalis (Cameron)				1	2						2	4		1	2	1
Charops bicolor (Szepligeti)		1			1						1					
Charops brachypterus Cameron					1											
Phygadeuontinae sp.1			1				1									
Porizontinae sp.1			1		1											
Ichneumonidae sp.1		1		1	4		1	1	3	2			1			1
Ichneumonidae sp.2	1		1	2	2	1	1	3		2	2				1	1
Ichneumonidae sp.3	3	1	1	1	1	2	1	2				2	1	1		
Ichneumonidae sp.4	6	4	2			1		4		1		1	2			2

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Ichneumonidae sp.5		2	1	1	1		2	5	2				1		2	
Ichneumonidae sp.6	2	2		1			3						1		2	2
Ichneumonidae sp.7		1	1								1	2				
Ichneumonidae sp.8				1	1					1			1		1	1
Ichneumonidae sp.9		1		1	5	2	1	2			1	5	7	1		2
Ichneumonidae sp.10	1				1	2		4	2	1	1		1	2	2	
Ichneumonidae sp.11	2				1		3	13			1	3		1		
Ichneumonidae sp.12		1			1											
Ichneumonidae sp.13					2		1	1		1	1					
Ichneumonidae sp.14	1				1		1	2	2		1	5	1			
Ichneumonidae sp.15			1				2		1		1	1	3			1
Euodynerus quadrifasciatus (Fabricius)															1	
Cerceris hortivaga Kohl											1					
Sphecoidae sp.1							1									
Brachyponera chinensis (Emery)		4			7						2			67		
Ectomomyrmex javanus Mayr	9	2	2	15	1	2	3									
Leptothorax koreanus Terahish	4	1														
Pheidole fervida (Smith)	12	100	1	2	5		2				2					
Solenopsis japonica Wheeler		8		8	7	3	5	49	77		2					
Tetramorium caespitum (Linné)	334	986	459	440	600	302	575	692	584	563	173	420	753	666	1559	561
Camponotus (Camponotus) japonicus Mayr	1	4	3	8	8	12	3		11	13	26	3		22	4	9
Formica (Serviformica) japonica Motschulsky	7	46	41	24	2	13	21	8	28	18	12	51	47	62	11	5
Lasius (Lasius) hayashi Yamauchi et Hayashida	2	9	27	2	5	4	23		4		24	10		45		
Paratrechina flavipes (Smith)	42	4	3	18	28	14	24	3	27	57	1	2	3			
Eumenidae sp.1						1										
Polistes mandarinus Saussure et Geer						1										
Polistes chinensis antennalis Perez					1	1										
Apis cerana Fabricius								1							1	
Apis mellifera Linné	7	2			14	1					4			2	3	
Sphecodes scarbricollis Westwood							2	4		1	5				1	2
Halictus aerarius Smith	3	4	1		1	1	1	2	1	1	1		1	1		1
Halictinae sp.1					1	1	5	19	7	4	2	1	4	4	1	3
Order Diptera																
Tipula (Yamatotipula) aino Alexander								1	3							
Tipula (Yamatotipula) patagiata Alexander								6			1					
Ptecticus tenebrifer (Walker)	2			1				1								
Cophinopoda chinensis (Fabricius)						1								1	1	

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Trichomachimus scutellaris (Coquillett)				2								1				
Asilidae sp.1	1															
Mesorhaga nebulosa (Matsumura)							2				1		3		5	2
Dolichopus nitidus Fallén	1	2	3	1	5	6	1	1	3				4			
Dolichopodidae sp.1		1	2		1	1	1	1					1			
Pipunculidae sp.1	14	3	3	11	28	40	47	37	8	35	111	55	21	50	69	37
Allograpta javana (Wiedemann)											5					
Allograpta balteata (de Geer)	2	5	2	1				1		1	2				1	
Paragus coreanus Shiraki	5	5	2		3			3	2		1	1	1		1	2
Betasyrphus serarius (Wiedemann)									1		5					
Metasyrphus corollae (Fabricius)												1				
Paragus quadrifasciatus Meigen			2	1	1		1		1							
Melanostoma mellinum (Linné)	1	1		6	3	6	1	3	5		6		2	2	1	
Eristalis (Eoseristalis) arbustorum (Linné)												1	1			
Sphaerophoria menthastri (Linné)	4	5	15	30	8	5	4	7	33	6	14	1	6	7	7	8
Eristalis (Eoseristalis) cerealis Fabricius			1													
Syritta pipiens (Linnaeus)	1		2			1	1	1		1	1					
Paroxyna sada Dirlbek et Dirlbekova									1							
Campiglossa hirayamae (Matsumura)		2					3		1			1	2			
Rivellia cestoventris Byun et Suh	4			2	12	4	1		3		1		1	20	59	10
Rivellia apicalis Hendel	4	1	4	1					7	3	1	8	5			
Sepedon aenescens Wiedemann	8	5			14	6	5	6	8	24	2	7	8	5	57	1
Sepsis monostigma Thomson	6	4	3	6	9	3	30	5	2	31	26	21	1		2	
Lauxaniidae sp.1	3	3	2	9	4	3	1		1	2	1	3	2	11	3	8
Ephydridae sp.1	4	48	2	4	7	1		2	61		2	59				
Anthomyiidae sp.1	33	20	2	11	47	34	10	9	5	11	4	17	8	49	27	12
Anthomyiidae sp.2	3		3		3	6	4	2	1	4	3	1	1	15	2	1
Lucilia caesar (Linné)				1		1										
Lucilia illustris (Meigen)	1				2	1	1	5		1		1	4	2	3	
Stomorhina obsoleta (Wiedemann)			2		1				1							
Calliphoridae sp.1	7			4		8						1	4		4	
Sarcophagidae sp.1			1	2	3					1						
Musca domestica (Linné)	2	4	1	1	1	2		1		2	1	2				
Muscidae sp.1	13	2	5	20	32	9		7	9	1	3	4	2	12	1	5
Gymnosoma rotundatum (Linné)		2	1	6	4	5		1	2	3		1			5	3
Cylindromyia (Cylindromyia) brassicaria (Fabricius)				1						4						
Tachinidae sp.1	5	4		8	12	14	1	11	3	3	2	4		10	9	

(Appendix 1. Continued)

Scientific name	Daejeon Streamside						Yudeung Streamside									
	D-1	D-2	D-3	D-4	D-5	D-6	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
Order Lepidoptera																
Scythris sinensis (Felder et Rogenhofer)											1					
Bradina geminalis Caradja				1		2	1				1		1	1		
Hymenia recurvalis (Fabricius)	1				2	2	1		1		2		1	1		4
Cnaphalocrocis medinalis (Guenée)				1		1								1	3	
Balataea octomaculata (Bremer)			1													
Thyris fenestrella seoulensis Park et Byun	1		2													
Miltochrista pulchera Butler	1															
Miltochrista miniata (Forester)	1															
Daimio tethys (Ménétriès)								1								
Lobocla bifasciata (Bremer et Grey)								1								
Ochlodes venata (Bremer et Grey)								1								
Parnara guttata (Bremer et Grey)							1							1	1	
Atrophaneura alcinous (Klug)							2						1			
Papilio macilentus Janson	1	1					1							1		
Papilio xuthus Linné								1								
Sericinus montela Gray										2						
Leptidea amurensis (Ménétriès)							1									
Artogeia rapae (Linné)		2	2		1	3	1	1					1		1	
Artogeia melete (Ménétriès)	1	1						1		1	1	2				
Colias erate (Esper)		1					1	2				1		1	1	
Gonepteryx rhamni (Linnaeus)	1															
Lycaeides argyronomon (Bergsträsser)							1			1						
Lycaena phlaeas (Linné)										1	1			1		
Celastrina argiolus (Linné)					3	3	1							1		
Libythea celtis Fuessly		1					1									
Neptis pryeri Butler							1				1					
Neptis sappho (Pallas)														1		
Vanessa indica (Herbst)							1									
Cyntia cardui (Linné)				1				1								
Polygonia c-aureum (Linné)	1	1			1			2		4	1		1			1