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Survey on Insect Fauna and Role of Insect Gardens for Ecotourism

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생태관광을 위한 곤충상 조사와 곤충 생태원의 역할

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ABSTRACT : This study was conducted to investigate insect fauna in the four insect garden sites of Suwon, Yeongyang, Buyeo and Yecheon from 2005 to 2007. Seasonal population size of insects was largest from June to August in all the four sites. In the four sites, Coleopteran insects were dominant followed by Hemiptera and Orthoptera. Unique education/learning programs are successfully run at the insect gardens based on the three geographic types (i.e. urban, mountainous and rural). These activities will help preserve insect biodiversity in the area and visitors better understand life forms such as insects found in the areas.

KEY WORDS : Biodiversity, ecotourism, insect fauna, insect garden, rural development

초 록 : 본 연구는 2005년부터 2007년까지 수원, 영양, 부여와 예천의 곤충 생태원 부지에서 곤충강의 다양성을 조사하였다. 월별 곤충 개체군 크기는 6월부터 8월에 네 조사구역 모두에서 가장 컸다. 전체적으로 딱정벌레목의 곤충이 가장 많이 채집되었으며, 노린재목과 메뚜기목의 곤충이 뒤를 이었다. 각 곤충 생태원은 지리적 특색에 맞는 고유한 교육프로그램을 운영하고 있었다. 이러한 연구와 생태원의 활동은 그 지역의 곤충과 같은 생물의 다양성을 보존하고 관람객에게 인식시키는데 중요한 역할을 할 것이다.

검색어 : 종 다양성, 생태관광, 곤충상, 곤충 생태원, 농촌개발

Major problems in the Korean rural regions are characterized by the decline of farmer populations, forming ageing society, abandoned farmlands, the income imbalance between the urban community and the rural community and poor infrastructure (Choi *et al*., 2004; Department of Environment, 1997, 1998). To improve the current situations in the rural regions, it is vital to establish appropriate strategies to explore, preserve and improve rural resources and amenities as a value added IT business (OECD, 2002). The sustainable development concept is important in protecting and conserving the environmental resources and at the same time meeting the basic needs of the people (Cho, 1999). Environmental preservation and sustainable development of rural regions

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would therefore be ideal alternatives in enhancing local businesses and welfare of the local people.

Survey on insect fauna was made to better develop the rural areas. The results showed that development of unique insect garden types and education/learning programs suitable to the geographic characteristics of the rural areas would help benefit both farmers and visitors.

Materials and methods

Survey sites

Four sites in Suwon, Buyeo, Yeongyang and Yecheon were selected to develop several insect garden models taking into consideration of the size and kind of landscapes. These insect gardens keeping their distinct local characteristics were developed and used as education/learning centers.

The insect garden in NAAS (National Academy of Agricultural Science) established in 1997 included bushes, grassland and agricultural spots and four ponds and canals. For species diversity, about 280 species of edible woody plants, bushes, grasses by insects were planted and showcased in the area (Latitude: 37.15.54, Longitude: 126.59.14, altitude: 34m). In addition to the artificial landscape, buildings were built to house and exhibit the various insect collections. Buyeo Bugs Country, on the other hand, had an aquatic insect garden, a Japanese rhinoceros beetle room, and a butterfly and stag beetle observatory (Latitude: 36.18.06, Longitude: 126.50.44, altitude: 68 m). The firefly eco-park in Yeongyang consisted of a firefly observatory, an insect rearing house, and an astronomical observatory (Latitude: 36.50.41, Longitude: 129.16.14, altitude: 351 m). Surveying the vicinity of Yecheon insect gaden started as of 2007 to build an insect garden (Latitude: 36.49.27, Longitude: 128.27.29, altitude: 412 m).

Data collection

Insect fauna

Insects were surveyed in two representative spots of 25 m^2 in each of the four areas. The surveys were conducted once a month from May to October from 2005 to 2007. Note that Yecheon area was included in 2007.

Insects were trapped in the cup containing decaying fish and syrup. Fifty cups were set up every 10 m away in each survey area. The cups were collected in the next day morning. Insects were likewise collected from the paddy fields during daytime using insect net. Collected insects were properly identified and certified by specialists of each insect orders.

Insect community analyses

Dominance index

The dominance of a species is represented by McNaughton's dominance, DI=(n1+n2)/N, where n1 is the number of individuals of the first dominant species, n2 is the number of individuals of the second dominant species and N is the total number of individuals of all species (McNaughton, 1967).

Diversity index

Insect species diversity in a community was determined using the Shannon-Wiever information function,

$$H' = -\sum_{i=1}^{s} Pi \cdot (\ln Pi),$$

where H' is diversity index, S is the total number of species an Pi the proportion of the number of a species to the total individuals of all species (Pielou, 1969).

Richness index

By using Margalef index (1958), species richness was calculated. Richiness index is RI=(S-1)ln(N), where S is the total number of species in the community and N is the total number of individuals in the community.

Evenness index

The evenness index was used to determine numerical equality of species in the community. Evenness index is E=H'/ln(S), where H' is derived from Shanon-Wiever information function, S is the total number of species in the community.

Statistics

Fisher's LSD post hoc analysis after analysis of variance (ANOVA) using the SPSS version 11.0 was done to determine the differences in the number of insect species among the survey sites and months on the SPSS version 11.0.

Results

Insect fauna of the survey sites

Approximately 130 ~ 300 insect species were collected from the four survey sites (Table 1, 3). This indicated that the sites were well preserved and suitable for the insects to inhabit. It was surmised that the four sites would be appropriate to establish insect gardens and learning centers. The least number of insects was collected from Suwon which was relatively more urbanized compared to the other three sites (Table 2).

The largest number of insect species was collected in June (Table 3). Insect species collected had decreased from the peak season until October (Table 3). Even though it was not statistically significant, the insect population densities in the four sites had decreased in October which indicated that more insect species had shifted to the dormant stage. This pattern was similar to the data collected from agricultural areas (Choi *et al*., 2004). Coleopteran insects were most prevalent in the four sites followed by Hemipteran and Orthopteran insects (Figure 1). The dominant species of each site are listed in Table 4.

Table 1. Insect fauna found in the four survey sites

Survey Sites	Order	Family
Suwon	8	89
Buyeo	11	108
Yeongyang	13	116
Yecheon	12	113

Table 2. No of insect species collected from May to October from each site

Survey Sites	N	Mean±S.D. of insect species	Total No. insect species
Suwon	6	22.3±13.2^{a}	134
Buyeo	6	44.5±26.3^{b}	267
Yeongyang	6	49.5±16.9^{b}	297
Yecheon	6	39.3±22.1^{b}	244

N represents the number of months from May to October
Df (3, 23): F=1.928, P>0.1
Post hoc analysis (Fisher's LSD) is significant at the 0.05 level

Table 3. Variation in the number of insect species by month

Month	N	Mean±S.D. of insect species	Total No. insect species
May	4	42.5±15.3^{ab}	170
June	4	53.8±32.6^{a}	215
July	4	45.8±27.9^{ab}	183
August	4	47.8±11.4^{ab}	191
September	4	26.3±15.0^{ab}	105
October	4	19.5±11.5^{b}	78

N represents the four sites
Df(5,23), F=1.678, P>0.1
Post hoc (Fisher's LSD) is significant at the 0.05 level

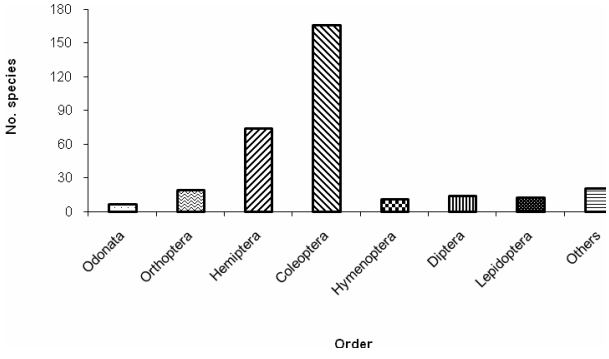

Fig. 1. Overall abundance of insect species by order from the four sites. Others include Ephemeroptera, Plecoptera, Blattaria, Mantodea, Dermaptera, Neuroptera, Mecoptera, Trichoptera.

Table 4. Dominant insect species in the survey sites

Site	Order	Species	No. Individuals
Suwon	Col.	*Galerucella grisescens*	39
	Ortho	*Loxoblemmus arietulus*	34
	Hemi	*Nysius plebejus*	30
Buyeo	Hemi	*Chauliops fallax*	224
	Hemi	*Nysius plebejus*	213
	Ortho	*Loxoblemmus arietulus*	70
Yeongyang	Ortho	*Atractomorpha lata*	213
	Ortho	*Oxya japonica japonica*	156
	Col	*Colpodes sp.*	114
Yecheon	Hemi	*Nysius plebejus*	153
	Hemi	*Carbula putani*	79
	Col	*Aleochara lata*	63

Ortho: Orthoptera; Hemi: Hemiptera; Col.: Coleoptera

Insect community in the four sites

Dominant index of Suwon was higher than that of other 3 sites and as predicted Suwon showed lowest species diversity. These imply that the urban modified environment is more suitable to certain insect species and that species diversity is rich in mountainous and rural areas. The other two indices also indicated that mountainous and rural areas provided better environment for the insects (Table 5).

Development of insect gardens and education programs

Based on the faunal data collected and geographic characteristics of the four sites, insect gardens and education programs have been developed (Table 6). The insect gardens have provided unique education programs. These programs can be viewed on the websites of each insect garden (Table 6). In addition to the social services provided by the gardens, souvenir items or products were made out of the insects found in each area. These items and products were sold to the visitors as an additional income for the local communities.

Discussion

Historically insects have imposed huge economic impacts to human societies by vectoring diseases, competing for food sources and nests, pollinating flowers, and producing honey and silk (Woyke, 1984; Altman *et al*., 2002; Guerin *et al*., 2002; Mainali and Lim, 2008; Jeong *et al*., 2009). However it was not long before people recognized insects as important components of an ecosystem and as tool for emotional relief. Insects have become more popular as human societies urbanized. Urbanization has also caused the income imbalance between urban and rural regions.

Based on the survey performed during 2005 and 2007, insect gardens focusing on the geographic characteristics of each site were built at the three sites (i.e. Suwon, Yeongyang, Buyeo). Accordingly, education/learning programs were developed such as insect collection, observing and rearing insects, insect sketch, discriminating sounds of acoustic insects, making insect toys and cages using natural resources such as wooden sticks, papers.

Such activities will help improve the productivity and increase the income of the farmers through the various educational programs offered and through merchandizing

Table 5. Analyses of insect community of the four survey sites

Index	Sites			
	Suwon	Buyeo	Yeongyang	Yecheon
DI	0.50	0.39	0.31	0.32
H’	2.40	2.93	3.09	2.80
EI	0.74	0.77	0.83	0.83
RI	5.92	8.37	8.45	6.80

Table 6. Insect gardens with their characteristics

Site	Type	Characteristics	Size (m^2)	Website
Suwon	Urban	Grassland, forests and a pond are constructed. Host plants are planted to attract insects.	30,000	http://goodinsect.NAAS.go.kr/cig/
Buyeo	Rural	Agricultural areas are well preserved. Rice fields are utilized for aquatic insects.	13,223	http://bugs.edutec.co.kr/
Yeongyang	Mountainous	Specimens and live insects are displayed. The firefly festival is annually held.	293,212	http://firefly.yyg.go.kr/
Yecheon	Mountainous	In association with the county insect research center, specimens and live insects are displayed.	38,000	http://www.ycinsect.go.kr/

souvenir items. Likewise, visitors to the insect gardens would have a better understanding and appreciation on the importance of insect fauna in the whole ecosystem. More natural resource-based industries such as insect gardens are yet to be seen in the near future.

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