# Insect Biodiversity Informatics in Korea

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**Abstract - Biodiversity data networking via the Internet together with molecular systematic bioinformatics recently becomes an issue in Korea, which naturally resulted in collecting both actual specimens and the data from them. Slowly evolving but strong trends on our biodiversity studies include biodiversity information networking based on XML, specimen-based gene banking for both morphological and molecular studies, and studies on environmental changes using new molecular techniques.**

## I. Introduction

Rapidly changing environment, together with industrial pollutions, threatens our nature and its biodiversity. Conservation efforts and studies on future bioresources let us to collect and data-mine organisms, and lead us to realize the importance of the basis of taxonomic and systematic studies.

There are about 1.7 million species known to the earth, and it estimates more than 12.5 million species when unreported species are included [1]. Insects, the most diverse and abundant group, covers more than 80% of all animal species, yet much more to be uncovered in the future.

About 12,000 species are known in Korea, which is about a third of all known species in Japan [2]. We believe the number of insects can be at least more than doubled in the future, but up until recently the governmental support on studying our biodiversity was limited, mainly due to "economy first"-based policy.

One of the important lessons we must take from the period of 36 years ruled by Japan till 1945 is that the number of studies on Korean insects by Japanese is rather surprisingly high. The numbers of taxonomic papers on Korean insects are about the same between for the 40 years until 1945 and for the next 40 years after 1945. This probably means the Japanese realized the importance of the natural resources long time ago and made an investment in scientific studies [2]. I also see Japan head-started on recent global biodiversity acts, and I hope the Korean government also actively participates in this earth-wide efforts.

Recent trends I could catch in the field of biodiversity-related studies in Korea, however, seems to be a positive sign. In relation to the field of insect systematics, I describe these recent works and trends, with a brief review on our history of biodiversity studies and related activities.

## II. Studies on Korean Insects in the Past

### A. *Studies in the Past*

In Korea, there are about 12,000 species of insects described. This, however, is known to be, at most, only a half of all Korean insect species. In land size, England is about the same as Korea and Japan is about 1.5 times larger than Korea, while the number of insect species reported from England and Japan is about twice and three times the number of Korean insect species, respectively [3]. This obviously tells us that the entomologists have to work a lot more on Korean insects and justify why the government has to pay more attention to our less known biodiversity, especially as we joined the 1992 Biodiversity Convention. Although we began to study our insect fauna more actively after 1980's (Table I), it has been true for the past that biodiversity activities on our environment had been always after industrialization.

TABLE I
The number of papers reported for different orders prior to 1990[4]

| PERIOD / ORDER | -1904 | 1905 -45 | 1946 -69 | 1970 -79 | 1980 -89 | Total |
|---|---|---|---|---|---|---|
| Collembola | | | 5 | 13 | 27 | 45 |
| Odonata | | 11 | 1 | | 3 | 15 |
| Orthoptera | | 5 | 3 | 1 | 5 | 14 |
| Hemiptera | | 18 | 15 | 7 | 8 | 48 |
| Homoptera | | 18 | 13 | 76 | 39 | 146 |
| Coleoptera | 26 | 296 | 79 | 54 | 136 | 591 |
| Lepidoptera | 21 | 318 | 80 | 71 | 99 | 589 |
| Diptera | | 11 | 55 | 40 | 46 | 152 |
| Hymenoptera | | 54 | 19 | 16 | 69 | 158 |
| Others* | | 8 | 1 | 8 | 7 | 24 |
| Generals | | 50 | 22 | 38 | 75 | 186 |
| **Total** | 47 | 792 | 294 | 330 | 515 | 1978 |

* Others includes all minor families reported less than five times.

### B. *Comparison in Lepidoptera*

A detailed comparison can be made in some lepidopteran groups among Korea and her adjacent countries. Over all, the number of described species in Korea is much less than half, perhaps near a third, of that in Japan, although a few exceptions are found due to strong activities in certain fields such as in the systematic studies on Gelechiidae (Table II) [5].

TABLE II
The known species of some Lepidoptera group in Korea and her adjacent countries

| Groups | World | China | Taiwan | Japan | Korea |
|---|---|---|---|---|---|
| Saturniidae | 10,100 | 56 | 16 | 23 | 11 |
| Drepanidae | 400 | 220 | 39 | 34 | 22 |
| Tortricidae | 4,500 | 286 | 223 | 569 | 350 |
| Lecithoceridae | 750 | 178 | 18 | 13 | 5 |
| Gelechiidae | 14,500 | 40 | 26 | 89 | 116 |

## III. Governmental Support on Biodiversity

### A. *Governmental Supports*

Since the Convention on Biological Diversity (CBD) was internationally activated, the government rearranged and upgraded the plans on biodiversity-related grants. The Ministry of Environment, Ministry of Science & Technology, and Ministry of Agriculture & Forestry support biodiversity studies each for conservation, for nature and human use, and for agriculture, respectively [6]. There are other support programs too, but no directly related grant for the CBD itself is allocated.

### B. *The Ministry of Environment*

The main support from the ministry is for the basic nation-wide survey of species through the National Institute of Environmental Research (NIER). For the period of 1997 to 2003, a total of 14.6 billion won (~ $12.2M) has been or will be used to survey 351 regions.

### C. *The Ministry of Science & Technology*

Three major areas are supported from the ministry to cover species diversity, genomic information, and genetic resources.

The biodiversity support program through the Korea Research Institute of Bioscience and Biotechnology (KRIBB) provides grants for collection and preservation of bioresources and biodiversity informatics. The activities include surveys and databasing of species diversity and publishing illustrated taxonomic handbooks. The budget spent for the last fiscal year was about 0.5 billion won (~ $0.4M).

The National Bioinformatics Center co-supported by the KRIBB and the Korea Institute of Science and Technology Information (KISTI) maintains several systems of databases and programs such as EST database, gene index, proteome analysis, gene expression information, and microbiological genomic information. 62 billion won (~ $51.7M) is planned for a decade from 2002.

The Korea Institute of S & T Evaluation and Planning (KISTEP) under the ministry recently planned for a national support program for genetic resources. This is to collect, maintain and supply many possible genetic resources under its networked umbrella for an effective use and application. The budget for the first year 2002 was about 2 billion won (~ $1.7M) and is planned for 60 billion won (~ $5M) for the next few years.

### D. *The Ministry of Agriculture & Forestry*

The Korea Forest Research Institute (KFRI) under the ministry has supported grants for biodiversity survey and management and collection of genetic resources for forest ecosystem. Last year, about 0.5 billion won (~ $0.4M) was spent.

## IV. Current Works and Plans on Biodiversity

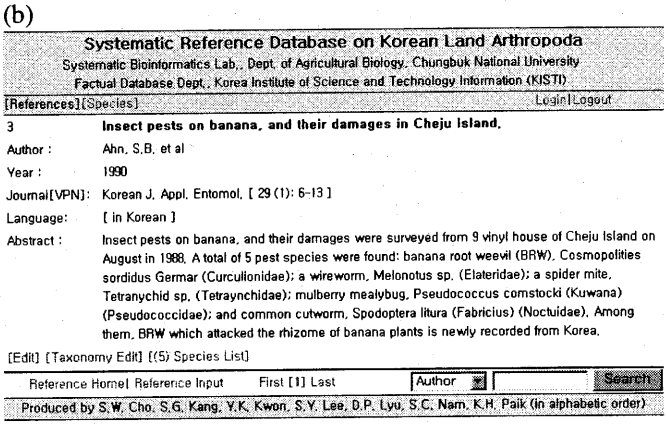
### A. *Collecting Specimens and Their Data*

No matter what kind of database techniques are used, the most important matter in establishing a network is the data themselves. Every use of bioresources, such as monitoring fluctuations and prediction of natural environment, or maintenance and effective use of genetic resources, can only be accomplished by continuous accumulations of specimens and the analyses of their data. The Korea Science and Engineering Foundation (KOSEF) supports grants for special research material banks, which include bioresource collection and preservation. More specimen-oriented program has recently been launched by the Ministry of Environment.

### B. *Networking Biodiversity Information*

While studies based on collection and preservation of specimens has an essential role for the study of biodiversity, reporting and sharing such information, both morphological and molecular data, have recently been a matter of concern. Current support on databasing biodiversity information let us recognize the necessity of networking these databases for high efficiency. For example, 12 databases have recently been created and supported by the KISTI (Fig. 1), who services these biodiversity informations through the Internet. (a)


(b)




(c)

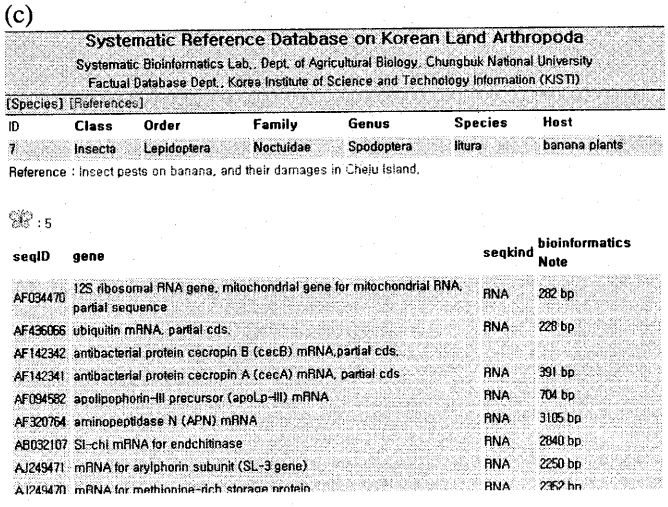



Fig. 1. (a) KISTI's biodiversity homage lists some biodiversity databases supported and mirror-sited by the KISTI (http://biodiversity.kisti.re.kr). (b, c) Sample result pages of insect biodiversity-related reference database of Korean land arthropods [7] are shown as an example of biodiversity databases at the KISTI site. Under this on-going project, reference or species search will bring us general information of the reference with its abstract as well as figures and drawings, and genetic notes if available.

Both specimen data and molecular data can all be integrated using XML (eXtensible Markup Language) recommended by the World-Wide Web Consortium (W3C). When a global road map is set, we can most efficiently manage bioinformatic data for biological conservation and applications. Several suggestions have been made for this global networking in Korea [8, 9], and this, I believe, will soon become a reality.

### C. *Molecular Genetic Studies and Environment*

The Ministry of Environment recently launched the Eco-Technopia 21 program and allocated 100 billion won (~$83.3M) per year for the next 10 years starting from 2001. There are a couple of sections where restoring bio-ecosystem and measuring level of pollution on organisms are included. A few proposals involve molecular genetic techniques, and these seem to be head-starters for a new trend.

One of the proposals, for example, involves developing molecular markers to distinguish polluted and unpolluted wetland areas by genetically surveying flag-ship species. A further technical development is planned so that genetic differences are distinguished between resistant group and sensitive group of a species under agricultural chemicals or other contaminants. These techniques may involve ESTs and/or DD-PCR.

## V. Conclusions

With recent big changes in computer and molecular biological techniques, the new millennium seems to be a bioinformatics era. In insect systematics, bioinformatic studies can be done in morphology-based systematics as well as molecule and gene-based phylogenetics. Bioinformatic studies can also be done in relation to environmental changes and their effects on organisms. Bioinformatics also leaves us in a big surf of integrated data systems. As long as we can hold keys tight and control them right, we may reach our goals much easier.

However, these are all with one big obligation: good data, or, in other words, scientifically useful specimens. We need long-term accumulations of specimens and related data. No data, no database; it's that simple. New techniques on databasing and molecular genetics can bring us new analyses on available data, but do not collect specimens for us.

The conclusion is that we do have enormous new techniques and enhancement on molecular bioinformatics and computer-based database, which let us study biodiversity much more efficiently and globally. I do hope we keep our pace with these new informations and techniques, together with consistent collecting and preserving actual specimens for diverse use.

One of my wishes on biodiversity studies in Korea is that we have some specially allocated grants for diverse international conventions on biodiversity, therefore let us do

more collaborative studies, such as biodiversity and conservation studies based on common insects like ants.

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