DEVELOPMENT OF THE ASIAN-PACIFIC ALIEN SPECIES DATABASE (APASD)

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ABSTRACT

Recently, the rate of introduction of invasive alien species has increased along with increases in global trade and human travel. The economic damage and ecological impacts caused by these invasive alien species have also been increasing. To resolve such problems and minimize the damage caused by alien species, we need an Internet database that can be used to easily accumulate and search data on various invasive alien species. For this purpose, the Asian-Pacific Alien Species Database (APASD) was introduced at an International Seminar held in Tsukuba, Japan, last year. Since then, aspects of the APASD system have been improved; for example, we have added a function to convert the English language APASD to other languages, and data input has continued. Here, we outline the functions of the APASD, give details of some of the features and additional functions, and address issues that will need to be overcome in the future.

INTRODUCTION

1. Why the database was developed

Increased worldwide trade and travel has accelerated the unintentional and intentional introduction of invasive alien organisms. Plants, animals including insects, and microbes have invaded many countries and are causing many problems in the Asia-Pacific region. To establish measures to prevent the spread of serious invasive species and minimize their economic and environmental impacts, we need to study their spread and predict their population dynamics in this region. At the same time, information on invasive alien species needs to be shared among countries to decrease the economic and environmental impacts of these invaders.

For this purpose, it is very important to develop an Internet database to enable the sharing of recent information on invasive alien species among Asia-Pacific countries. This database needs to be operated as a valuable regional resource in association with an international database on invasive alien species.

2. Progress of development of the database after the International Seminar

An International Seminar, “Biological Invasions: Environmental Impacts and the Development of a Database for the Asian-Pacific Region”, cosponsored by NIAES (National Institute for Agro-Environmental Sciences) and FFTC (Food and Fertilizer Technology Center for the Asia-Pacific region) was held in November 2003 at Tsukuba, Japan. As the title of the seminar indicates, the development of a database on invasive alien species was an important aim. As a result we...
set up a database system named the Asian-Pacific Alien Species Database (APASD; http://apasd-niaes.dc.affrc.go.jp/apasd2/), which was intended to accumulate and transmit information on invasive alien species. Currently we do not have enough data and require more on invasive alien species in Japan and other countries.

We have improved the APASD system since the seminar. Improvements include a function for converting the language from English to other languages, including Japanese (see below).

**Profile of APASD**

The database system was demonstrated at last year’s International Seminar (Yamanaka and Matsui, 2003). However, it is very important that we introduce it again here from a different perspective, because many people attending this Workshop are not familiar with it. We give an outline below.

1. **Operating system**

   The technical features of the database are as follows. The database is relational and is operated in English. APASD is designed to run on Linux-based systems using an Apache server. The network uses the PHP server-side language to interact with a PostgreSQL database.

2. **Database structure**

   This database has a four-layer structure: the first part is for users who read the data on the Internet; the second is for contributors who input data; the third is for general administrators who input organism names and synonyms and register data input by contributors into the regular system; and the fourth is for special administrators who register IDs and the passwords of contributors and general administrators (Fig. 1).

   The database is constructed of two systems: one is a temporal system whereby contributors input data, and the other is the regular system whereby users can see data. General administrators check the data input by contributors to the temporal system and then register it in the regular system (Fig. 2). General administrators can renew master tables such as species names, what’s new, links, and some categories such as information on the species’ establishment situation, possibility of hybridization, habitat and so on.

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**Fig. 1. Layer structure of the functions of the APASD**

<table>
<thead>
<tr>
<th>Readers</th>
<th>They can only search and read the data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributors</td>
<td>They can input data, photos and literatures in the APASD by e-mail or by the direct input through each own password.</td>
</tr>
<tr>
<td>General administrators</td>
<td>They administrate the master table of the organism names and the other master tables, and the registration of data, photos from temporary to regular system.</td>
</tr>
<tr>
<td>Special administrator</td>
<td>He administrates IDs and passwords of contributors and general administrators</td>
</tr>
</tbody>
</table>
FEATURES OF APASD

1. Relational database

The APASD can store a large amount of information on many invasive alien species in many countries. Contributors can input many data items, and can modify, add, or delete them easily and rapidly. Users can easily search for and read much information on specific species and items. Because contributors can renew their data anytime, it is easy to obtain updated information on invasive alien species.

2. Asia-Pacific region

The target of the database is the Asia-Pacific region, with emphasis on the Asian region. The region is very wide and includes different biogeographical areas, but there are some common characteristics; for example, the countries exist in neighboring zones and are being seriously invaded by invasive alien species from other, relatively distant biogeographical regions such as North and South America.

3. Target species

The target species of the APASD are those organisms (for example, plants, insects, nematodes, mammals, other animals, fungi, bacteria, viruses) that have invaded agro-ecosystems. The APASD includes information on both species that cause economic damage and species that have environmental impacts on biodiversity (Fig. 3).

4. Type of information

The purpose of the APASD is to help prevent the invasion and spread of these species and to decrease the economic and environmental damage caused by them. Therefore, we need to input information that is useful for early detection, emergency control, integrated pest management (IPM) and risk assessment. Data on invasive alien species such as plants, insects, nematodes, mammals, other animals, fungi, bacteria, and viruses are accumulated with regard to taxonomy, establishment, distribution, environmental impact, economic damage, reproduction, growth, countermeasure, habitat, photographs of alien
species and damage, and reference literature (Fig. 4). If a very important species has invaded certain countries, contributors in those countries can input updated data and inform clients in countries where the species is already present or where there is a threat of invasion.

5. Comparison of species data among countries

Users can compare various types of data about a target species among countries. For example, users can compare data on the expansion of distribution areas of the golden apple snail, Pomacea canaliculata, among Taiwan, Philippines and Japan (Fig. 5); these data were input by local contributors. Users can compare the data on 10 items such as expansion, environmental impacts, economic damage, reproduction, growth and control strategies shown at the upper part of the page where species list is indicated. This makes it easy for users to understand the status of species invasion in various countries and to confirm the validity of the data by comparison.

6. Use of references

In this database, it is desirable for data to be described with reference to not only literature written in English but also that written in the native language of each participating country. However, the titles of papers written in native languages must be translated into English for input to the database. Contributors can input not only summaries and whole papers but also data and figures such as distribution areas and annual spread as personal communications in PDF format that exist in reference table.

FUNCTIONS ADDED TO THE DATABASE SINCE THE SEMINAR HELD IN JAPAN LAST YEAR

1. The ability to convert the English-language APASD to new APASDs written in other languages

The APASD is written in English to disseminate information on invasive alien species among the countries of Asia-Pacific, because English is the most universally accepted language for this purpose. However, APASDs in local languages are needed to help clients such as farmers, local government officers, and extension officers in each country to understand the information easier. A comment in this regard was made at last year’s seminar at Tsukuba.

For this purpose, we have developed a new function that converts the APASD written in English to APASDs in other languages. For example, we have made a Japanese language APASD. The specialist can perform this work.
Fig. 4. The kinds of input data of the APASD

- Photo (alien & relative species, damage)
- Description (taxonomy & morphology)
- Native region
- Expansion (speed, route, distribution)
- Ecological impact (competition, hybridization)
- Economic impact (damage, yield & economic loss)
- Reproduction (type, rate, eggs, seeds)
- Growth (diapause, developmental period, threshold temperature)
- Prohibit invasion (quarantine, regulation by the environmental law)
- Prohibit expansion (nursery movement, restriction of contaminated area)
- Control (emergent control, eradication, IPM)

Fig. 5. Comparison of the data of specific items on a species among countries
to translate the words from English to each language (Fig. 6). Collaboration between NIAES and institutes in other countries is needed for the development of new APASDs that operate in languages other than English.

2. Screening of target literature from a list of all input literature saved in the master table

Users can search the literature by using keywords from a master reference table. Many references input by contributors for various invasive alien species are stored in a master reference table. Users can search the literature by selecting ‘Search for reference’ on the upper part of the page and then keying in the author’s name and/or part of the title and/or keywords.

3. Synonyms for species names

Sometimes the same organism has different taxonomic names. For example, the same organism may have different order or family names, or even different species names. In this database, if users click “substantially same species (Group)” under the organism name in the main table, a list of synonyms or substantially same species appears on the next screen (Fig. 7). Then users can search for all data on the species by visiting each of the synonyms and substantially same species one by one.

**PROBLEMS TO BE OVERCOME IN THE NEAR FUTURE**

1. Construction of a network of co-workers in Asia-Pacific countries is a very important priority if we are to accelerate the data input. We respect the cooperative relationship among the attendees of last year’s International Seminar in Japan and this year’s Workshop in Taiwan. We would like to choose data from the proceedings of the International Seminar and Workshop and add them to the database in cooperation with our co-workers.

2. If any institutes in Asian countries want to develop new APASDs that can be read easily by farmers, extension officers, and others, then they can be developed through cooperation with our institute, NIAES. As there is no direct connection between the English version APASD and any native language version APASDs,
administrators in each country can manage their own native language APASDs freely (Fig. 8). It is therefore important that we translate and input data for each other and store it in each database, with copyright permission.

3. We need to build up a good relationship with the international database. In particular, we need to reinforce relations with international projects and their databases on invasive alien species (for example, with the Global Invasive Species Programme, GISP). GISP would like each local region and country to have its own database and aims to be linked to those databases. As we need to ensure the taxonomic accuracy of invasive alien species, there is a need to complement any insufficiencies in the taxonomic data in the APASD. For this purpose, links to taxonomic databases such as Lucidcentral (www.lucidcentral.org/keys/v3/aquarium/Aquarium%20Plants.html) are very important.

4. Until now, we have focused principally on improving the frame of the database system, but now the focus of improvement will shift more toward making the database easier to use by listening to users’ opinions.

Discussion and conclusion

In recent years, the economic and environmental damage caused by invasive alien species has been increasing worldwide and in the Asia-Pacific region. Measures to control these species are being enforced internationally and in each country, but efforts to disseminate the results of studies on, and experience with, invasive alien species in each country by the Internet have only just begun. We have a rare opportunity to share information on invasive alien species by the constructing a common database for the Asia-Pacific region.

GISP, an international organization, conducts activities such as international conferences in an effort to strengthen the capacities of local regions and countries to fight invasive alien species. The Invasive Species Specialist Group (ISSG), a part of GISP, has developed a database (http://issg.appfa.auckland.ac.nz/database/welcome/) and a list of “100 of the world’s worst invasive species” (http://issg.appfa.auckland.ac.nz/database/species/search.asp?st=100ss&fr=1&st=...
However, this database covers only a small number of invasive alien species, such as agricultural pests, that inhabit agro-ecosystems. GISP recommends the building of a database in each local region and each country, and emphasize the links to those databases. The Asia-Pacific Economic Cooperation (APEC) has working groups that are concerned with efforts toward making the identification system of invasive alien species, such as plants and aquatic organisms, for diagnostic purposes. However, it seems that the construction of a database on invasive alien species targeting the Asia-Pacific region is not yet complete. In the future, if the APASD becomes widely recognized as a good tool for the investigation and dissemination of invasive alien species, it may develop a close relationship with the efforts of the APEC.

In 1992, the Convention on Biological Diversity (CBD) was adopted internationally. The CBD states that one of the serious threats to biodiversity is invasive alien species, and that each country should prevent the introduction of, control, or eradicate those alien species that threaten ecosystems, habitats, or species (Article 8 (h)). Furthermore, the CBD states that the exchange of information should include the exchange of results of technical, scientific, and socioeconomic research, as well as information on training and survey programs, specialized knowledge, and indigenous and traditional knowledge (Article 17) (www.biodiv.org/convention/articles.asp). Thus the development of the database on invasive alien species is recognized to be very important by the CBD, too.

The APASD has been further developed since the International Seminar held in Tsukuba. Technical improvements have continued, and it has become easier to use and the system was nearly complete, although we still need more data. We need to increase the amount of data by inputting the results of studies and information in Japan and by adding information from the proceedings of the
Seminar held last year and this Taiwan Workshop. From now on, international networking will be very important, including networking among the participants who attended the International Seminar and the International Workshop.

We expect that addition of the language-conversion function will lead to the development of new APASDs, which will operate in Asian native languages. To achieve this aim, there needs to be collaboration between institutes in Asian countries and NIAES.

Finally, we expect that the database will grow steadily, and that, in the long term, it will become a useful tool for the development of sustainable agriculture and conservation of the environment in Asia-Pacific countries. We expect that the database will facilitate communication on the issue of invasive alien species between persons in various countries. To achieve this aim we need the cooperation of all interests involved in the countries of Asia-Pacific.