

## Essential elements of online information networks on invasive alien species

Annie Simpson<sup>1,\*</sup>, Elizabeth Sellers<sup>1</sup>, Andrea Grosse<sup>1</sup> & Yan Xie<sup>2</sup>

<sup>1</sup>National Biological Information Infrastructure, US Geological Survey, Mail stop 302, 12201 Sunrise Valley Drive, Reston, VA, 20192, USA; <sup>2</sup>Institute of Zoology, Chinese Academy of Sciences, 25 Beisihuan Xilu, Beijing, 100080, China; \*Author for correspondence (e-mail: [asimpson@usgs.gov](mailto:asimpson@usgs.gov); fax: +1-703-648-4224)

**Key words:** GISIN, I3N, IABIN, NBII, ISIN, CSIS, EA–NA Network, interoperability, IAS, invasive species, invasive species databases, multinational cooperation, transborder issues, information systems, information management, distributed networks, cross-search, online

### Abstract

In order to be effective, information must be placed in the proper context and organized in a manner that is logical and (preferably) standardized. Recently, invasive alien species (IAS) scientists have begun to create online networks to share their information concerning IAS prevention and control. At a special networking session at the Beijing International Symposium on Biological Invasions, an online Eastern Asia–North American IAS Information Network (EA–NA Network) was proposed. To prepare for the development of this network, and to provide models for other regional collaborations, we compare four examples of global, regional, and national online IAS information networks: the Global Invasive Species Information Network, the Invasives Information Network of the Inter-American Biodiversity Information Network, the Chinese Species Information System, and the Invasive Species Information Node of the US National Biological Information Infrastructure. We conclude that IAS networks require a common goal, dedicated leaders, effective communication, and broad endorsement, in order to obtain sustainable, long-term funding and long-term stability. They need to start small, use the experience of other networks, partner with others, and showcase benefits. Global integration and synergy among invasive species networks will succeed with contributions from both the top-down and the bottom-up.

### Introduction

IAS-related damage to biodiversity and society is estimated at USD\$1.4 trillion *per year*, based on a per capita extrapolation from calculations for six major geopolitical units (Pimentel 2002). This is 5% of the world economy and equivalent to the gross domestic product of China for 2003 (IMF 2003). IAS respect no borders and so must be addressed transnationally. There is a pressing need for information to support a response to the global impact of IAS. But to be effective, this information must be placed in the proper context

and organized in a logical, preferably standardized manner.

Recent efforts to organize IAS information have resulted in the creation of distributed online networks for sharing information through cross-searchable databases. We compare four examples of existing IAS online information networks with global, regional, and national scopes, and discuss a plan for developing a successful Eastern Asia–North American IAS Information Network (EA–NA Network) proposed at the Beijing International Symposium on Biological Invasions (BISOB), 08–15 June 2004. We hope this will (1) encourage

discussion on how to improve global IAS information sharing, and (2) provide models for other regional collaborations.

## Global Invasive Species Information Network

### *History and background*

After issuing a Call to Action in 2001 (Convention on Biological Diversity Secretariat 2001), the Global Invasive Species Programme (GISP) initiated and coordinated seven regional workshops to assess the global IAS threat, impact, and needs. These and other related workshops resulted in several declarations, such as the Kirstenbosch Declaration from South Africa and the USA (Kirstenbosch Declaration 2000); the Copenhagen Declaration from the nations of the Nordic/Baltic region (Copenhagen Declaration 2001); the Brasilia Declaration from South American nations (Brasilia Declaration 2001); and the Davis Declaration from North America and Southern Africa, (Davis Declaration 2001). Reports delivered by the nations involved in the seven GISP regional workshops all identified common needs, among them sharing information and building capacity.

The idea of a Global Invasive Species Information Network (GISIN) has been discussed in different forums since the Millennium (Ricciardi et al. 2000; CBD 2002; Simpson 2004). Providing unified access to the world's IAS information systems will dramatically assist decision-makers in the effort to control the effects of IAS. With the objective of implementing the GISIN, 76 information specialists from 26 countries met in April 2004 to determine the kinds of information and formats needed to achieve interoperability between IAS information systems. Results were consolidated into the Global Invasive Species Information Network (GISIN) proceedings (Sellers et al. 2004b).

### *The GISIN today*

The GISIN is currently the *only* distributed global IAS information network. In preparation for the experts meeting to implement the GISIN, an electronic discussion included a survey that was

taken by 60 participants from 26 countries representing 37 IAS information systems. A cataloged list of online IAS information systems was also created in preparation for the meeting (Sellers et al. 2004a) as part of a white paper reviewing the GISIN in the context of the Convention on Biological Diversity (Sellers 2004). Currently incorporating 230 entries and including biodiversity databases that contain IAS information, the list continues to be developed.

The GISIN survey identified data availability, formats, standards, protocols, system designs, and the resources used in the development of existing IAS (and some non-IAS) information systems. In addition, desirable characteristics of IAS information systems were submitted by respondents. This information was discussed by five breakout groups at the meeting and presented in the GISIN proceedings. The results of the survey did not highlight any one style of information system development as being common or popular among respondents. In fact a great variety of information system types and styles were represented by respondents, a reflection of the diversity of reasons for which information systems are developed. The GISIN community generally agrees that the freedom to design systems according to their needs should not be limited or defined by their involvement in a network like the GISIN. However few respondents reported the use of standards or formats for information management in the design of their information systems. In the absence of common standards and formats, the connectivity or cross-searchability of networked systems is often impeded or even prevented. Cross-searchability is a key component of a successful electronic information network. Therefore the GISIN's mission in facilitating IAS information system interoperability (without limiting future information system design and development) will require identification and agreement on standards and formats for IAS information management.

GISIN participants identified six main types of information systems that should be cross-searchable for those seeking IAS information, and we recommend two more:

- (1) species profiles (fact sheets on individual IAS)
- (2) experts (individuals with special expertise)

- (3) observations (of IAS or invasion events)
- (4) specimens (as in museum collections)
- (5) bibliographies (for digital and non-digitized documents)
- (6) projects (describing all kinds of IAS research)
- (7) images (online digital photos and other images)
- (8) spatially explicit information (distribution, longitude/latitude)

As part of its mission to provide an information gateway for sharing IAS information at a global level, the GISIN is working on reaching consensus for common information standards for these types of information systems (Baltimore Declaration 2004). The GISIN may become a thematic node of the Global Biodiversity Information Facility (GBIF), and thereby achieve interoperability for IAS specimen data (Edwards 2004).

A conceptual model of the distributed network that has been proposed for the GISIN can be seen in Figure 1 (Saarenmaa 2004). This model can also be followed in the development of distributed online networks at regional and national levels.

### Regional invasive species information networks

#### *Eastern Asia–North American IAS Information Network (EA–NA network)*

An Eastern Asia–North American IAS Information Network was proposed at the Beijing International Symposium on Biological Invasions

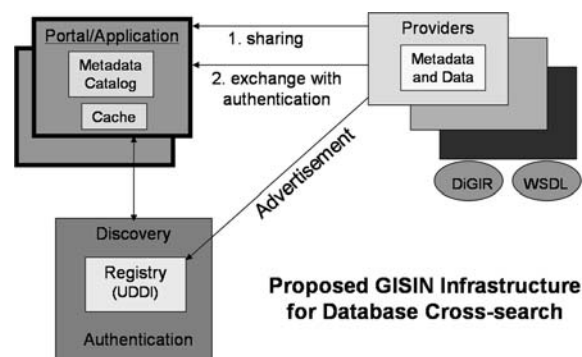


Figure 1. Conceptual model of distributed network, being followed by the GISIN.

(BISOBI), 10 June 2004, during the session on IAS online networks. There were 50 participants (from 35 organizations in seven countries) who indicated interest in contributing to this proposed network (Appendix A). The creation and comparison of species lists is a requirement for comprehensive information sharing about species of common concern between the regions. A benefit of this network will be the ability to easily compare species information in their native and non-native ranges, and automatically generate more complete lists of this type for use in invasive species science. In the meantime, the authors and other collaborators have begun to create IAS lists of mutual concern.

Organizers of the BISOBI session on IAS online networks also prepared a Beijing Declaration to create a regional network that will follow the standards of the GISIN. The Declaration was adopted during the final session of the BISOBI (Y. Xie, unpublished document).

#### *Inter-American Biodiversity Information Network (IABIN) Invasives Information Network (I3N)*

The I3N has been in existence since 2001. It created a set of tools adopted by 12 countries in the Americas and an additional five countries are also planning to adopt them (see Figure 2). These tools are made freely available to organizations in the other areas of the world. The I3N promotes basic premises of information sharing and capacity building that can be followed by other regional IAS networks as well as by the GISIN. I3N is being promoted as a regional prototype for the GISIN.

I3N consists of a distributed network of four catalogs per provider (country): invasive species lists, experts, projects, and datasets. Each provider's invasive species information is controlled by the provider but is documented and posted on the Web in a standard format. The public can search the records for free from a single entry-point. I3N is managed by the National Biological Information Infrastructure (NBII). Seed funding was provided by the US State Department and the US Geological Survey. Software tools were developed by the NBII to assist with cataloging and distributed searching. With new funding



Figure 2. Map showing coverage of I3N. Dark grey: The IABIN Invasives Information Network (I3N) pilot project participants were Argentina, Brazil, Bahamas, Chile, Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Mexico, Paraguay, and the USA. Light grey: Bolivia, Colombia, Haiti, Peru, Uruguay and Venezuela have stated interest in joining the network.

allocated for the next 5 years, I3N will grow in depth and breadth.

Numerous benefits were obtained by participants, such as the creation of a country's first digital database focusing on IAS; providing public access to unpublished or scattered data; arousing interest in IAS among the country's scientific community; contributing to the development of a national strategy on IAS; assistance in the identification of gaps in knowledge and institutional

capacity; and enabling the exchange of IAS information between institutions and with other countries. Further information, including the cross-country search, individual national Web sites and catalogs, can be found on [http://www.iabin-us.org/projects/i3n/i3n\\_project.html](http://www.iabin-us.org/projects/i3n/i3n_project.html).

### National networks

Several IAS networks have developed within China and the USA. We will briefly discuss one example from each country.

#### *Chinese Invasive Species Network*

The China Species Information System (CSIS) is hosted by the Conserving China's Biodiversity Web site, and can be found at <http://www.chinabiodiversity.com/shwdyx/ruq/ruq-index-en.htm>, and a searchable database is at <http://www.chinabiodiversity.com/search/aspecies/english/ealist.shtm>. Managed by the China Program of Wildlife Conservation Society and the Chinese Academy of Science Institute of Zoology, it offers invasive species research information in English and Chinese. The system includes a searchable database that returns species fact sheets, taxonomic data, natural range, invaded range in China (including distribution maps), reasons for introduction, impacts, control measures, and bibliographic information. The CSIS is contributing to IAS information management in China by working with biogeographic units, linking invasive and native species information systems, linking to protected area systems, and developing criteria for defining and selecting IAS for inclusion in the database (China Species Information System 2004).

#### *USA National Biological Information Infrastructure (NBII) Invasive Species Information Node (ISIN)*

The ISIN is a thematic node of the NBII, which is a Web-based collaborative program to provide increased access to data and information on biological resources. The NBII links diverse, high-quality biological databases, information products, and

analytical tools maintained by partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry. The ISIN facilitates communication and cooperation among different invasive species projects being undertaken by regional and thematic nodes across the NBII (NBII 2004). At the international level, the ISIN provides the US lead for I3N and coordinates the GISIN.

The ISIN also coordinates the biological informatics contribution to a national collaborative invasive species early detection and rapid response information system, which was mandated by the US National Invasive Species Council's Management Plan (National Invasive Species Council 2001). This system will be developed over the next 5 years, and involves federal, state, academic, and non-governmental partners. It is designed to consolidate and Web-enable a robust suite of tools that will allow users to identify, report, and respond to threats from invasive plants, animals and pathogens at scales ranging from backyards to the national level (National Institute of Invasive Species Science 2004).

### Discussion of commonalities and differences

To effectively communicate across a network, common standards for information sharing are essential. At all levels, networks face the dilemma of reaching consensus among members that follow different standards (or none at all). One solution is creating a protocol to enable communication between two systems that may be using different standards, such as the Z39.50 standard in library science, which seamlessly links different electronic systems. Another is defining essential and mandatory data fields. Reaching consensus on standards of many types (and adhering to them) makes possible the process of cross-searching information from many systems at once.

Even more basic to their organizational success, networks must have a mission with broad appeal. The networks discussed here have missions that can be briefly described as follows:

- GISIN: to make IAS information systems cross-searchable around the globe, through a common gateway

- EA-NA Network: to increase data sharing on invasive species native to one region and invasive to the other, or invasive to both regions
- I3N: to promote a distributed but cross-searchable regional network of catalogs and species lists, and to increase national capacities throughout the Western Hemisphere
- CSIS: to better understand the role played by IAS in China and make policy recommendations to ensure that invasions do not negatively affect China's biodiversity
- ISIN: to encourage the sharing, standardization, completeness, and accessibility of existing information on non-native plants, animals, and diseases across the USA, especially related to early detection and rapid response.

These are all distributed information systems. Some of the advantages of distributed information systems (as compared to centralized information systems) are as follows: partner investment can be variable and according to their own capabilities; there is less susceptibility to total system breakdown; data management is performed by local owners with the greatest interest in its maintenance; and there is greater system flexibility and capacity for gradual change. If one only considers the difficulties related to reaching consensus on international decisions, a distributed network is the realistic option for a large invasive species information system.

In online IAS networks, as with any network, funding becomes more difficult to obtain in situations where ownership is less clear, i.e., at regional and global levels, and where it requires innovation and growth. The national effort, ISIN, depends on continued funding from the US Congress, which is expected to increase as products are developed that demonstrate its success. Seed funding for the regional effort, I3N, was awarded to 11 nations of the Americas with national nodes being maintained by each country. A second round of external funding for 2005–2009 is expected to expand the network. Globally, the need for a GISIN has been discussed for at least 4 years, but even minimal funding has been difficult to obtain to date.

At the global level, the emphasis is on standardizing existing databases. I3N on the other hand, emphasizes increasing capacity so that all

participants can have their own information systems. National programs tend to have a narrower focus that may emphasize a specific problem or approach.

## Conclusions and lessons learned

### *Start small*

The I3N network accomplished a lot in its first years because basic and well-designed tasks were set as goals: compile available information on species lists, experts, projects, and datasets. The ISIN began with three small projects related to consolidation of datasets, species profile creation, and IAS identification. The EA-NA Network will focus on compiling data from a few species of common concern. Starting small is often referred to as “harvesting the low-hanging fruit,” an approach that is especially appropriate where funding is limited.

### *Search for and cultivate active leaders and contributors*

Participants with a vision and the time and energy to achieve it are essential to any network's success. Active and dynamic individuals will keep a network running with very little encouragement. These leaders are willing to take risks with new ideas and move ahead even without full participation. Development of the EA-NA Network is being led by an enthusiastic supporter and member of the IAS scientific community from the Philippines who has begun the organization of volunteers in spite of no immediate funding prospects. Leaders usually identify themselves by coming forward of their own volition to volunteer their services. Such charismatic people excel at noting the strengths of others and making them want to contribute. Even small amounts of funds made available to these natural leaders can keep a developing network alive. Often, an organization's token recognition of its leaders and contributors will form a dual purpose: gaining respect for the leader/contributor within the network, and increased public exposure for the network about

the benefits it provides, which may attract other organizations and potential leaders.

### *Be prepared for setbacks*

Sometimes all the elements of a project do not advance at the same pace. I3N struggled during its first year with bugs in its custom-designed software and delays in the processing of funding paperwork. The ISIN operated on minimal funds to develop partnerships and create a Web presence during its first 2 years. The GISIN proposed a funding toolkit as a major deliverable from its 2004 meeting, but the toolkit development will be delayed for at least another year. In spite of these setbacks, all three networks are progressing.

### *Don't reinvent the wheel*

One hears this repeatedly at meetings and within the scientific community. “Reinvented wheels” often appear as new databases, because it is easier to find money for developing a new database than for database collaboration, adaptation, improvement, or maintenance. However, when the ISIN had an immediate need for invasive species profiles, the initial idea to design a new database to house the profiles was rejected (to avoid reinventing the wheel). Instead, a partnership was formed with the Invasive Species Specialist Group, managers of the existing Global Invasive Species Database. Since the partnership began, the amount of information in the database has more than doubled and a redesigned version is available in two hemispheres, at <http://www.issg.org/database> and <http://www.invasive-species.net/database>. I3N is also reusing and not reinventing a data tool: it is expanding its first database with international input, adding functionality and drawing on the experience of its members and others. I3N's experience and involvement is sought after by new countries even outside the Western Hemisphere.

### *Partner with others*

Partnering provides synergy on funding, utility, and design. It also assures a broader buy-in on standards development and use of the network.

For example, the EA–NA Network will be jointly led by members from China, the Philippines, and the US. The GISIN's interim Steering Committee includes representatives from Brazil, China, Denmark, Malaysia, Morocco, and USA, as well as connections through its members to GISP, GBIF, IPPC, I3N, CABI, BioNET, ISSG, and other multinational organizations (see Appendix B for abbreviations).

### *Showcase benefits*

The benefits realized through participation in a network will make a strong case for recruiting participants. Making others aware of these initiatives will increase the likelihood of collaboration and decrease duplication of effort. Diverse benefits resulting from I3N participation ranged from creating a first registry of national species, specialists, and projects, to creating an IAS photo collection (Grosse 2004). It is important to keep track of and celebrate network successes by sharing these achievements with others. Small, in-kind contributions by institutions in host countries are sometimes all that is necessary to maintain the core nodes of a network, as demonstrated by I3N member countries (e.g., see CONABIO 2004; CRIA 2004; INBIAR 2004; Institute of Jamaica 2004; Instituto Horus 2004; I3N 2004a; OTECBIO 2004).

### **Acknowledgements**

Special thanks to Ravindra Joshi, who has kindly offered to organize the EA–NA Network. Discussion of I3N benefited from meetings and conversations between I3N participants in many countries: Sergio Zalba, Monica Sonaglioni, Stacy Moultrie, Vanderlei Perez Canhos, Dora Canhos, Silvia Ziller, Beatriz Ramírez, Marina Hernandez, Bienvenido Santana, Brigido Hierro Garcia, Antonio Matamoros, Jorge Quezada Díaz, Blanca Aragon, Reginaldo Reyes Rodas, Suzanne Davis, Laura Arriaga, Patricia Koleff, Nelida Rivarola, Carolina Pedrozo Silva, Antonio Salas, Mary Klein, Alvaro Espinel, Barbara Bauldock, and Dimitri Norris.

## **Appendices**

### **Appendix A. Organizational affiliations of the volunteers to the proposed Eastern Asia–North American Invasive Alien Species Information Network (EA–NA Network).**

Organization	Country
Brown University	USA
Center for Population Biology, University of California - Davis	USA
China University of Mining and Technology	China
Conservation Biology Institute	USA
Cornell University	USA
Department of Agriculture	Australia
Fudan University	China
Harvard University Herbarium	USA
Institute of Animal and Plant Quarantine	China
Institute of Botany, Chinese Academy of Sciences (CAS)	China
Invasive Plant Atlas of New England (IPANE)	USA
Japanese Ministry of the Environment	Japan
La Ville de Sherbrooke	Canada
Long Island University	USA
Nanjing Institute of Environmental Sciences (SEPA)	China
Nanjing University	China
National Biological Information Infrastructure	USA
National Geomatics Center of China	China
PanJab University	India
Philippine Rice Research Institute (PhilRice)	Philippines
Purdue University Calumet	USA
Research Institute for Bioresources, Okayama University	Japan
Research Institute of Tropical Forestry (CAF)	China
Rutgers University	USA
SAIC–USGS/EROS Data Center	USA
School of Life Science, Nanjing University	China
Seoul National University	Korea
Smithsonian Environmental Research Center	USA
South Florida Water Management District	USA
State Environmental Protection Administration (SEPA)	China
Sun Yatsen University	China
University of Connecticut	USA
University of Florida	USA
University of Tokyo	Japan
US Geological Survey	USA

During the BISOB, 50 participants from these 35 organizations volunteered to join an Eastern Asia–North American Invasive Alien Species Information Network.

## Appendix B. Acronyms.

---

BioNET = BioNET INTERNATIONAL, the Global Network for Taxonomy  
 BISOBI = Beijing International Symposium on Biological Invasions  
 CABI = CAB International. Formerly known as Commonwealth Agricultural Bureaux International  
 CBD = Convention on Biological Diversity  
 CSIS = Chinese Species Information System  
 EA-NA Network = Eastern Asia-North American IAS Information Network  
 GBIF = Global Biodiversity Information Facility  
 GISIN = Global Invasive Species Information Network  
 I3N = IABIN Invasives Information Network  
 IABIN = Inter-American Biodiversity Information Network  
 IAS = invasive alien species  
 IPPC = International Plant Protection Convention  
 ISIN = Invasive Species Information Node of the NBII  
 ISSG = Invasive Species Specialist Group of the Species Survival Commission of the IUCN  
 IUCN = World Conservation Union  
 NBII = National Biological Information Infrastructure  
 US or USA = United States of America  
 USD = United States dollars  
 USGS = United States Geological Survey

---

## References

- Baltimore Declaration (2004) Technical Workshop on the Implementation of a Global Invasive Species Information Network (GISIN). Retrieved from <http://invasivespecies.nbii.gov/as/BaltimoreDeclaration.htm> on 14 October 2004
- Brasilia Declaration (2001) Prevention and Management of Invasive Alien Species Workshop: Forging Cooperation in South America. Portuguese/Spanish/English version retrieved from [http://www.iabin-us.org/projects/i3n/background\\_documents\\_declaracaobrasilia.doc](http://www.iabin-us.org/projects/i3n/background_documents_declaracaobrasilia.doc) on 28 September 2004
- China Species Information System (2004) Alien Invasive Species in China. Retrieved in English and Chinese from <http://www.chinabiodiversity.com/shwdyx/ruq/ruq-index-en.htm> on 21 September 2004
- CONABIO (2004) I3N-Mexico (Programa Especies Invasoras de Mexico.) Retrieved in Spanish from [http://www.conabio.gob.mx/conocimiento/info\\_especies/especies\\_invasoras/doctos/especiesinvasoras.html](http://www.conabio.gob.mx/conocimiento/info_especies/especies_invasoras/doctos/especiesinvasoras.html) on 20 September 2004
- Convention on Biological Diversity Secretariat (2001) A Global Strategy on Invasive Alien Species, prepared by the Global Invasive Species Programme. Retrieved from <http://www.biodiv.org/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-09-en.pdf> on 28 September 2004
- Convention on Biological Diversity Secretariat (2002) Sixth Conference of the Parties to the Convention on Biological Diversity, Scientific and Technical Cooperation and the Clearing-House Mechanism: Report of the Joint Convention on Biological Diversity/ Global Invasive Species Programme Informal Meeting on Formats, Protocols and Standards for Improved Exchange of Biodiversity-Related Information. Retrieved from <http://www.biodiv.org/doc/meetings/cop/cop-06/information/cop-06-inf-18-en.pdf> on 25 April 2004
- Copenhagen Declaration (2001) Managing Invasive Alien Species: Forging Collaboration in the Nordic-Baltic Region. Retrieved as an image file from <http://www.zin.ru/projects/invasions/gaas/images/declar1.gif> on 28 September 2004. Retrieved as html text, appearing as Appendix 2, from <http://www.ocean.univ.gda.pl/baltder/polsiec/projskora.htm> on 28 September 2004
- CRIA (2004) I3N-Brasil (Rede de Informação Sobre Especies Invasoras de Brasil.) Retrieved in Portuguese from <http://i3n.cria.org.br/> on 30 September 2004
- Davis Declaration (2001) Workshop on Development of Regional Invasive Alien Species Information Hubs, Including Requisite Taxonomic Services, in North America and Southern Africa, 14–15 February 2001, Davis, California. Retrieved from [http://ice.ucdavis.edu/Davis\\_Declaration/](http://ice.ucdavis.edu/Davis_Declaration/) on 28 September 2004
- Edwards JL (2004) Research and societal benefits of the Global Biodiversity Information Facility. *BioScience* 54: 485–486
- Grosse A (2004) I3N: IABIN Invasives Information Network, Presentation for Experts Meeting on the Global Invasive Species Information Network. Retrieved from [http://www.iabin-us.org/projects/i3n/i3n\\_documents/i3n\\_powerpoint\\_presentations/i3n\\_public\\_presentations.html](http://www.iabin-us.org/projects/i3n/i3n_documents/i3n_powerpoint_presentations/i3n_public_presentations.html) on 01 October 2004
- IMF (International Monetary Fund) (2003) World Economic Outlook Database. Retrieved from <http://www.imf.org/external/pubs/ft/weo/2003/01/data/> on 26 October 2004
- INBIAR (2004) I3N-Argentina (Base de Datos sobre Invasiones Biológicas en Argentina.) Retrieved in Spanish from <http://www.uns.edu.ar/inbiar/> on 01 October 2004
- Institute of Jamaica (2004) I3N-Jamaica (IABIN Invasive Species Information Network Project, Jamaica.) Retrieved from <http://www.jamaicachm.org.jm/Catalogue/Bibliography/Display-Type/QryBibliography.htm> on 30 September 2004



- Instituto Horus 2004 Levantamento de Espécies Exóticas Invasoras: Resultados preliminares (I3N-Brasil) Retrieved in Portuguese from [http://www.institutohorus.org.br/trabalhosa\\_basedados.htm](http://www.institutohorus.org.br/trabalhosa_basedados.htm) on 15 October 2004
- Inter-American Biodiversity Information Network (IABIN) Invasives Information Network (I3N) (2004a) Benefits obtained by I3N Countries. Retrieved from [http://www.iabin-us.org/projects/i3n/i3n\\_products\\_after\\_pilot/benefits\\_to\\_countries.html](http://www.iabin-us.org/projects/i3n/i3n_products_after_pilot/benefits_to_countries.html) on 27 October 2004
- Kirstenbosch Declaration (2000) South Africa/United States of America Bi-National Commission's Symposium on Best Management Practices for Preventing and Controlling Invasive Alien Species, 24 February 2000, Cape Town. Retrieved from <http://www.invasivespecies.gov/new/kirstenbosch.htm> on 28 September 2004
- National Institute of Invasive Species Science (2004). Retrieved from <http://www.niiss.org> on 15 October 2004
- National Invasive Species Council (2001) Meeting the Invasive Species Challenge. Retrieved from <http://www.invasivespecies.gov/council/nmp.shtml> on 26 August 2004
- NBII (2004) Invasive Species Information Node. Retrieved from <http://invasivespecies.nbii.gov/> on 08 July 2004
- OTECBIO (2004) I3N-Guatemala (Especies Exóticas Invasoras de Guatemala.) Retrieved from [http://www.geocities.com/otecbio\\_especies/](http://www.geocities.com/otecbio_especies/) on 30 September 2004
- Pimentel D (2002) Biological invasions: economic and environmental costs of alien plant, animal, and microbe species. CRC Press, Boca Raton/London/New York/Washington DC, p. 369
- Ricciardi A, Steiner WM, Mack RN and Simberloff D (2000) Toward a global information system for invasive species. *BioScience* 50: 239–240. Retrieved from <http://sgnis.org/publicat/papers/riccstei.pdf> on 26 August 2004
- Saarenmaa H (2004) The Global Biodiversity Information Facility and GISIN. In: Sellers E, Simpson A, Fisher JP, and Curd-Hetrick S (eds) Experts Meeting on Implementation of a Global Invasive Species Information Network (GISIN), Proceedings of a Workshop, 6–8 April, 2004, pp 66–71, Baltimore, Maryland, USA. Retrieved from <http://www.gisinetwork.org/Documents/ProceedingsPDF/GISIN%20Proceedings%202004.pdf> on 31 May 2005
- Sellers E (2004) Databasing Invasions: A Review in the Context of the Global Invasive Species Information Network (GISIN). Retrieved from [http://www.gisinetwork.org/Documents/Databasing\\_Invasions\\_A\\_Review\\_ESellers\(IIa\).htm](http://www.gisinetwork.org/Documents/Databasing_Invasions_A_Review_ESellers(IIa).htm) on 31 May 2005
- Sellers E, Simpson A and Curd-Hetrick S (2004a) List of Invasive Alien Species (IAS) Online Databases and Databases Containing IAS Information. Retrieved from <http://www.gisinetwork.org/Documents/DraftIASDBs.htm> on 31 May 2005
- Sellers E, Simpson A, Fisher JP and Curd-Hetrick S (eds) (2004b) Experts Meeting on Implementation of a Global Invasive Species Information Network (GISIN), Proceedings of a Workshop, 6–8 April, 2004, Baltimore, Maryland, USA. Retrieved from <http://www.gisinetwork.org/Documents/ProceedingsPDF/GISIN%20Proceedings%202004.pdf> on 31 May 2005
- Simpson A (2004) The Global Invasive Species Information Network: what's in it for you? *BioScience* 54(7), 613–614. Retrieved from [http://www.gisinetwork.org/Documents/04\\_July\\_Viewpoint\\_Simpson.htm](http://www.gisinetwork.org/Documents/04_July_Viewpoint_Simpson.htm) on 31 May 2005