

Cross-Cutting Issues

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This workshop provided a first step toward identifying needs and approaches to develop a national database, or network of databases, on invasive species. A primary objective was to present an overview of existing and emerging invasive species databases within the U.S., across a broad range of ecosystems and taxa. Throughout the

two-day workshop, participants also highlighted significant gaps in available information on invasive species and identified key data or functions that are critical, but now lacking, to address pressing management and policy needs in this area. Many presentations identified similar gaps and needs, underscoring the cross-cutting nature of these issues among the diverse array of databases and interests represented. Here, the cross-cutting issues which were discussed are reviewed.

Database Function and Goals

The desired function of a database is of paramount importance in guiding its design and evaluating its utility. Within the U.S. and overseas, resource managers and scientists are increasingly calling for more comprehensive databases to assess risks associated with invasive species and develop effective management strategies to minimize their impacts. More specifically, such databases can provide a powerful tool to:

- Characterize patterns of invasion in space and time according to species, taxonomic group, transport mechanism (or vector), habitat, latitude, and a suite of biological characteristics.
- Identify ecological and economic impacts of known or potential invaders.
- Develop predictions and risk analyses about patterns and effects of invasion, based upon empirical data (above).
- Establish management strategies to prevent/control invasions by particular species or vectors, using empirical analyses to set priorities with limited financial resources.
- Assess the efficacy of management strategies to abate the rate of invasive species invasions.

Although a variety of databases on invasive species presently exist within the U.S. (described herein), these include collectively a small portion of the information needed from a research and management perspective to provide the above function. Most databases focus on a relatively narrow range of taxa, leaving many taxonomic groups unexplored. Even the existing databases are incomplete for their selective taxa, including data for a subset of species, geographic regions, invasion characteristics, and biological attributes. At best, current efforts have resulted in an uneven patchwork of data on invasive species with many significant gaps.

Expanding the present databases to create more comprehensive information on invasive species, as an effective research and management tool, remains a major challenge. There are many important aspects and obstacles to evaluate in undertaking such an effort, and some of these are discussed below.

Database Design: Next Steps

To increase the value and function of existing databases, we must expand the taxonomic coverage as well as breadth of information included within taxa. This is perhaps best achieved as a network of databases by taxa and habitats, instead of a single centralized database. A decentralized model creates better opportunities to take advantage of existing expertise and develop strong relationships with end-users, who may differ among taxonomic groups.

However, it is not simply enough to gather more data on more species, as the usefulness of expanded databases will depend upon developing standards for nomenclature, information content, information quality, and compatibility among databases. Such standards should be designed to achieve a relatively high level of resolution on key information fields (e.g., spatially or temporally referenced data, biological attributes) that is often absent in current databases, limiting their utility. Importantly, standardized approaches and compatibility will permit queries across databases (taxa) that are not now possible, and enhance opportunities for linking databases for management, research, and public uses.

Commitment and Continuity

Opportunities to expand, standardize, and integrate existing databases, which together create a strong management and research tool, are contingent upon long-term commitment and continuity. To date, lack of sustained funding and support infrastructure has been a critical deterrent. Pulses of funding have certainly been available to create a wide variety of databases. However, with few exceptions, such funding is short-lived and generates a relatively streamlined, static database. Although the resulting products may be well-suited to their original purpose, these do not function as comprehensive and national-scale databases (as above). Instead, development toward this goal requires (1) funding explicitly for this purpose, (2) long-term continuity to create and sustain dynamic (i.e., current and evolving) databases, and (3) programmatic coordination to develop standards, integration, and access among databases.

Taxonomy and Reference Material

Our ability to use and improve databases of invasive species also depends in large part on the quality of taxonomic identification and information. A significant problem exists in the area of taxonomy that greatly limits our capacity to detect, describe, and control invasive species. There are now many groups for which taxonomic experts no longer exist in the U.S., as resources and expertise in taxonomy have continued to erode over the past decades. Thus, organisms now arriving to the U.S. often are not identified

appropriately, identification (if attempted) may be greatly delayed, and associated risks of colonization and impact cannot be assessed.

More broadly, taxonomy and reference collections are both integral parts of establishing more comprehensive, useful databases on invasive species. In addition to initial identifications, maintenance of voucher or reference collections for comparative analyses and confirmation is of great value. Ideally, such reference collections would include both morphological and genetic vouchers, as many recent studies have found invasiveness and the magnitude of impacts can vary greatly by genotype.

Information Sources

Although there is clearly much information available presently to develop more comprehensive databases across all taxonomic groups, it is a misconception that all needed data have been collected. For example, there are many regions and habitats within the U.S. for which we do not have contemporary surveys of biota within the past 50 years, and some areas have never been surveyed. As a result, we now have a very incomplete picture of the extent, pattern, and impact of nonindigenous species invasions. Without adequate baseline data, it is impossible to assess the threat of invasive species and develop management strategies in undersurveyed regions. More fundamentally, the lack of such baseline data also limits our ability to assess the efficacy of management strategies on the rate of invasions. Thus, as we contemplate development of more comprehensive databases as management tools, we must recognize gaps in available data and consider strategies to collect further data where needed.

Data Access and Linkage

A critical issue for access to existing and future databases remains. Ideally, information within databases can be readily accessible to a broad range of users, from agencies and managers to researchers and the public. This requires considerable forethought. Information from databases is variously available among many dispersed websites and individual/ institutional database managers. As we evolve toward expanded and integrated databases, there is a broad range of issues to resolve concerning:

- Data ownership and timetable for public access.
- Directories and metadata standards for databases.
- Technologies for access to databases.
- Degree of integration and linkage among databases.
- Technology for linkage among databases.

Interaction with the international community creates another important dimension for both access and linkage of databases. Although overseas access to U.S. databases may not present any novel problems, the overall value of our databases could be greatly enhanced by linkage and some integration with overseas databases. At minimum, the opportunities for compatibility and synergism should be explored, and directories to international databases should be developed as a potentially important resource.

Outreach

Although the importance of public access to information is well recognized, the need for public support and understanding for the value of databases has received relatively little attention. Outreach programs have certainly been effective in describing the threat associated with particular invasive species (e.g., zebra mussel, green crab, brown tree snake) and value of management activities directed at these species. A similar effort should exist to articulate clearly the value, function, and need for comprehensive databases on invasive species.

Conclusions

It is evident that comprehensive information on invasive species is required to develop effective management that minimizes the risks and impacts of alien species. As a result, databases will play a pivotal role in both creating and assessing policy actions. Careful attention should be given to the appropriate development and implementation of such databases, to maximize function and utility. Although a variety of useful databases now exist on invasive species, these do not satisfy the present national need for comprehensive databases. We presently lack sufficient programmatic support and coordination to adequately develop such databases. This should be a top priority for action under the Executive Order on Invasive Species.