Public Access to Biodiversity Information via the Web

Belize Biodiversity Mapping Service

The newly established Belize Biodiversity Mapping Service makes spatially-enabled biodiversity information available via a public website. Students, NGOs and government agencies are the primary users. For financial sustainability, the BBMS was developed using open-source map-server, database and web-scripting technologies.

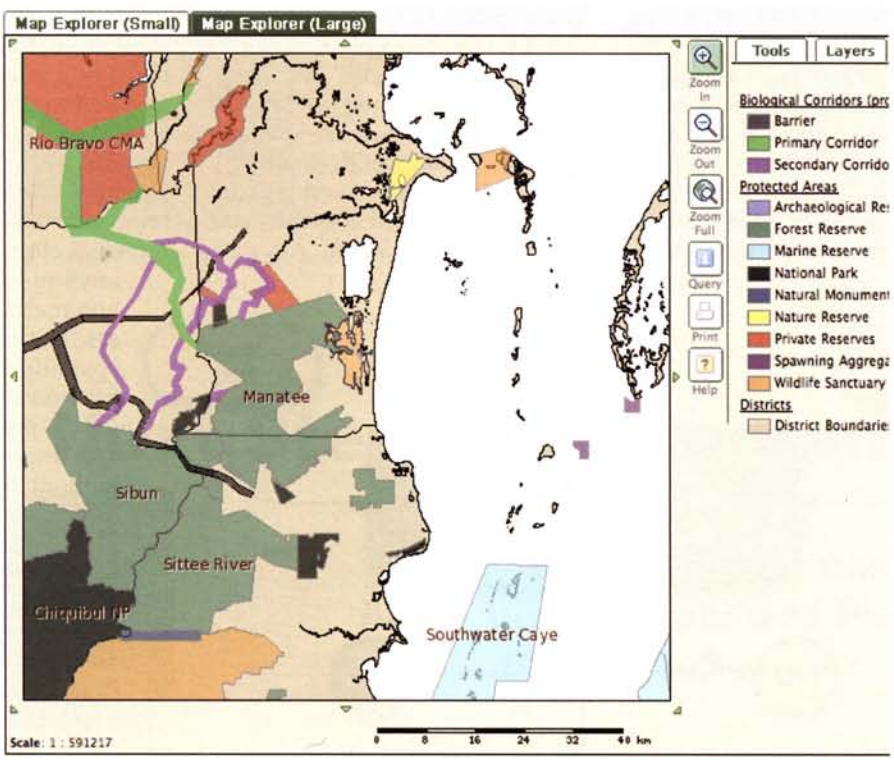
By Jan Meerman, Jerod Clabaugh and Marydelene Vasquez, Belize

Whilst scientific investigation strives to improve the extant knowledge base, traditionally the results have been accessible only to an elite group of scientists. The Age of Technology is, however, rapidly democratising information of all types and opening up the world of science to anyone with a computer and an internet connection. But old habits die hard, and there is a lot more information out there than can be easily accessed by the general public. Recognising how critical information is to decision making, international NGOs and funding agencies are increasingly promoting Web-based clearing-house mechanisms as the way to make vital scientific information available to a wider audience. At first such efforts were focused on non-spatial databases, but attention has now turned to spatially enabling these databases, and map server technologies for the World Wide Web are advancing to meet these needs.

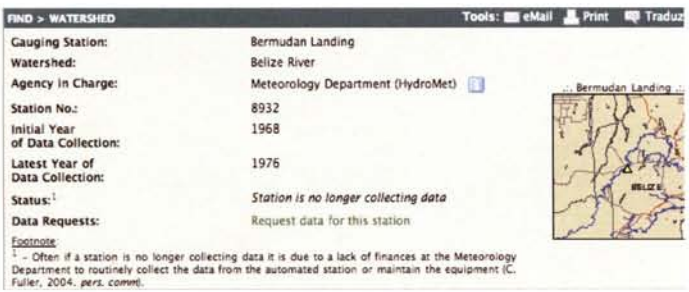
Non-accessible Data

Belize is a country in Middle America bordered by Mexico, Guatemala, and the Caribbean Sea to the north. In a survey undertaken in 2002, *Baseline Diagnosis of the State of Biodiversity Research in Belize*, 2,354 publications were found that contained scientific information relating to the biodiversity of Belize. Astonishingly, only 20% of those publications (or copies thereof) were found physically to reside somewhere in Belize; of this 20%, approximately half of the document collections in the offices of biodiversity-related organisations are catalogued. This indicates how difficult it is to locate a physical document in Belize. There exists a great need for free, easy access to this information. But Belize is not unique in this situation; the same may be found in many other developing countries.

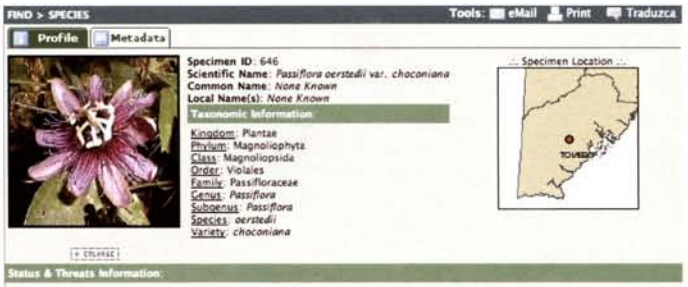
In a 2004 study, *User Needs Assessment for the Belize Biodiversity Clearing-House Mechanism*, conducted among 29 government agencies and non-government organisations, a little more than half (55%) of those polled either possessed or had direct access to some sort of GIS equipment and 66% purported to have GIS-trained staff. However, 38% of all agencies interviewed stated their wish to give much higher priority to GIS equipment and staffing procurement, if funding allowed. Regardless of their current or desired equipment and staffing resources, few



Map Explorer application showing protected areas and connecting (proposed) biological corridors in east-central Belize.



Profile of hydraulic gauging station showing embedded, dynamically generated map of its locality.



Portion of data profile for single, collected biological specimen showing embedded, dynamically generated map of its location.

agencies felt they had adequate access to accurate and current GIS datasets with which to do their jobs effectively.

Prototype Server

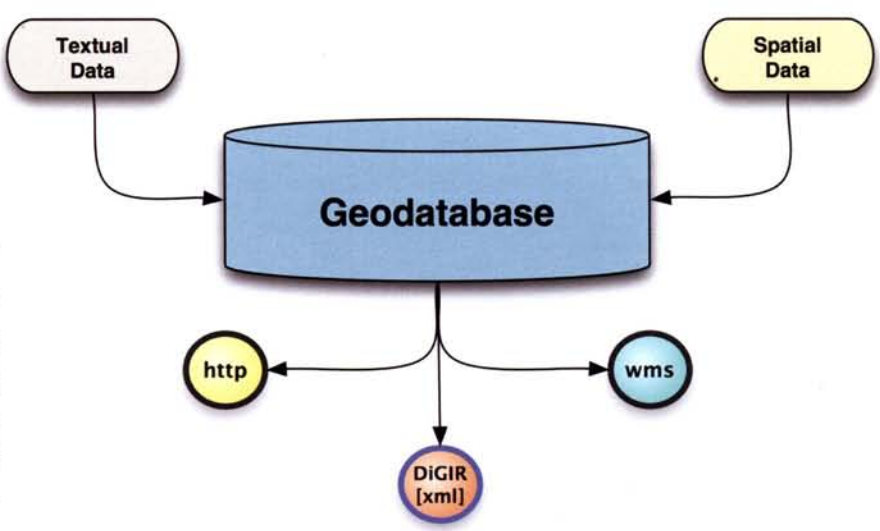
In an initial attempt to address both biodiversity and GIS data availability, the Belize Biodiversity Mapping Service (BBMS) was developed as a prototype Internet Mapping Server. Its purpose is to test the applicability of internet-based dissemination of biological data in a geospatial context. This system was based upon the University of Minnesota's MapServer CGI application and was basically an Internet Mapping Application. The initial system was moderately successful, allowing access to more than thirty environmental data layers, including some specimen locality information; most layers were produced in-house. User feedback indicated limited usefulness of this solution due to a lack of user interface functionality and biodiversity data. The system needed to allow for the discovery and visualisation of a wide variety of biodiversity information (e.g. specimen localities, publications, statistics, images, associated people, projects) within both spatial (map) and non-spatial (textual) contexts.

Clearing-house

To truly satisfy the national need for large volumes of biodiversity information and to provide easy access to geospatial data, this new system would have to integrate geospatial data features throughout a more conventional, Web-based environmental information system. A new system was created through joint partnership between the Belizean NGO Belize Tropical Forest Studies and a USA-based development firm, TransNatura LLC. The system is based on the concept of an 'information clearinghouse', its structure being centred on a relational database that has been spatially enabled (PostgreSQL/PostGIS), where biodiversity and spatial data can be stored together and relationally associated. All data records are geo-referenced, providing a spatial component to all data, regardless of type: specimen, document, person, organisation, ecosystem, protected area etc.

Integrated Approach

This new system is based in part on MapServer API and is written in PHP/MapScript. The old mapping application has been rewritten, providing a variety of enhancements. These include better zooming and measuring capabilities, better on-screen layer management and a novel visual search technology that allows the identification of non-spatial data using the map interface. The geodatabase allows the system to utilise mapping technologies outside a standard 'mapping application', including the embedding of smaller, dynamically generated maps in regular Web pages (such as profile pages for species, protected areas, ecosystems). The system also provides limited, dynamic on-the-fly spatial overlay and analysis capabilities, thereby eliminating enormous amounts of data entry and automating common analyses. This means that accurate, spatially-based information for non-spatial data records like a person, document or specimen can be obtained without having to resort to direct use of the mapping application. Extensive use of bibliographic (Dublin Core), taxonomic (Darwin Core) and geospatial (CSDGM) metadata standards and the Distributed Generic Information Retrieval (DiGIR) protocol, in addition to MapServer WMS/WFS services, allow the system to seamlessly share biodiversity and spa-



The natureSmith geodatabase, combining spatial and textual data into one enterprise-level relational data system with multiple modes of output.

tial data with other biodiversity-related initiatives.

Future

TransNatura has opted to spin off the underlying code-base of the new system into a commercial Web application called 'natureSmith'. But both the Web application system and the BBMS database have been chosen as the foundation for a new Belize government-supported joint national initiative: the Belize Biodiversity Clearing-House Mechanism (CHM) and the Belize Environmental Information System. This joint initiative will allow the long-term goal of BBMS – the provision of access to quality GIS and biodiversity data - to be maintained and enhanced both at national and regional level.
All major producers of biodiversity and natural resources management-related information will become data providers to the CHM, greatly enhancing overall system functionality and usefulness while providing additional data necessary to begin using the new system as a centrally-accessible national data repository. The integration of spatial and non-spatial data will enable the system's use as a planning and decision-making tool. It is to be launched during the first half of 2005.

Further Reading

- Meerman, J. C., Clabaugh, J., 2004. Belize Biodiversity Clearing-House Mechanism - User Needs Assessment Technical Document, unpublished report to the Forest Department, Ministry of Natural Resources, Environment and Industry, Belize. 235pp. www.mnrei.gov.bz/dms/dm_browse.asp?pid=39.
- Meerman, J. C., 2002, Base line diagnosis on the state of research on biodiversity in Belize, unpublished report to the Mesoamerican Biological project, www.biological-diversity.info biodiversity_stats.htm.

Using the Map Explorer to search for non-spatial data resources.

Websites

www.transnatura.com/belize
http://biological-diversity.info
www.naturesmith.net ◆

Biography of the Authors

Jan Meerman

Jan Meerman is trained as an ecologist, having received two bachelor degrees from the University of Wageningen, The Netherlands, in biology and ecology. As a resident of Belize since 1989, he is one of the foremost experts on biodiversity in that country. He is currently director of Belize Tropical Forest Studies, a national NGO.

Jerod Clabaugh

Jerod Clabaugh received a master's degree in conservation biology from UCLA and has eight years experience developing environmental information systems for the GEF, OAS, FAO and others. He is currently the director of TransNatura LLC, which developed the original BBMS system, and more recently the 'natureSmith Web application system' which forms the basis for the Belize Biodiversity Clearing-House Mechanism.

Marydelene Vasquez

Marydelene Vasquez received a master's degree in GIS from the University of Edinburgh. She was senior manager and technical coordinator for a Belize environmental NGO, Programme for Belize, and has successfully run her own local GIS consulting firm. Ms Vasquez is currently in charge of the Regional Environmental Information System for the GEF/CCAD/World Bank Mesoamerican Barrier Reef System Project, based in Belize City.

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