WILDSPACE™ DSS: An Expert System for Exploration of Multi-scale Species and Habitat Scenarios

ISAAC W. WONG[1], PHIL FONG[1], DONALD K. McNICOL[2], ROBIN G. BLOOM[2], CATHERINE CHEN[1], RICHARD RUSSELL[2], AND ANGELA DARWIN[2]

[1]National Water Research Institute, Environment Canada, 867 Lakeshore Road, Burlington, ON, L7R 4A6, Canada
[2]Canadian Wildlife Service (Ontario Region), Environment Canada, 49 Camelot Drive, Ottawa, ON, K1A 0H3, Canada, email don.mcnicol@ec.gc.ca

Key Words: species at risk, decision support system, critical habitat, database design, data integration, Canada

Extended Abstract: Canada's *Species at Risk Act* (SARA) facilitates recovery of a wide variety of taxa at risk in Canada by protecting them, their residences, and the critical habitats on which they rely. At present, there is no single system to store, retrieve, analyze, and interpret information on species at risk and their critical habitats. To support the range of information requirements needed for SARA, it is highly desirable to develop network designs, infrastructures, and applications that link distributed data sources into an integrated system that manages data and provides decision support. This paper provides an overview of a data model and data integration framework developed by the Canadian Wildlife Service (CWS [Ontario Region]) for tracking species and their habitats within the versatile WILDSPACE™ Decision Support System (hereafter referred to as WILDSPACE DSS) (Wong et al. 2003). Background information on Project WILDSPACE and its infrastructure, and sample applications related to species at risk are discussed.

The WILDSPACE DSS was designed to help manage wildlife and environmental information in Ontario and beyond. The system is an analytical, planning, and management tool used by scientists, resource managers, and decision makers to carry out complex queries on the temporal and spatial distribution of wildlife, and on relevant habitat data. At present, the DSS contains approximately 85 biological and environmental databases from CWS core programs. The most recent additions to this collection of databases is a Species at Risk Data Management System for information on migratory birds and all taxa on federal lands in Ontario (i.e., taxa for which Environment Canada is directly responsible).

Risk to the survival and recovery of species at risk is manifested through impacts to individuals/populations or to locations/habitats on which they rely. In order to facilitate efficient access to knowledge about such issues, WILDSPACE DSS contains resident data that can be integrated 'on the fly' with geographic map layers and tabular data provided by the user. The current generation WILDSPACE DSS facilitates integration of diverse information ranging from species life history data, to map layers of species occurrences and habitat, to species productivity data. In addition to Environment Canada's information holdings, a suite of conversion tools are

available for integrating 'user data' in the form of shapefiles and databases. Once the desired datasets are imported, the system provides opportunities to query a variety of data, visualize spatial and/or temporal patterns, and analyze data using standard and customized tools. Inherent to the WILDSPACE DSS architecture are both relational databases, with common design structures for seamless integration, and a hierarchical spatial framework for multi-scale analysis.

In addition to existing data holdings, implementation of the *Species at Risk Act* will require new databases that respond to information needs imposed by the Act. In particular, life history information, population monitoring data, and information on residences and critical habitat are recognized as being core data needs. In response to these information requirements, a Species at Risk Data Management System has been developed within the Species and Spaces framework.

The WILDSPACE Species at Risk Data Management System is composed of data tables for life history, population monitoring, and habitat quality information for each taxon that Environment Canada is responsible for under the Act. Design and modification of the data tables is driven by lookup tables which allow practitioners to define the parameters and data properties on a species-by-species basis using standard rules and naming conventions specified in metadata. This approach provides flexible data definitions defined by administrators/project leaders while placing constraints on data entry by lower level users once the definitions are in place. A graphic interface guides the user through the data entry process. Manual data entry is characterized primarily by a lookup framework in which manual character input is minimized but governed by validation rules and input masks where text entry is necessary. In the event that raw data are already in electronic format, batch mode record imports are also facilitated.

Once sufficient data are in the system, resident analytical routines can be applied to explore information on species, habitat, and their interaction. For example, statistical modeling of relationships using linear models is offered in the existing version, and alpha testing of a stochastic, spatially explicit resource selection function routine (*sensu* Manly et al. 1993) for predicting patterns of species occurrence is underway. Such tools provide a means of objectively identifying priority sites for protection by simulating and recording the impacts of the removal of individual sites on the efficacy of recovery. In addition to gaming of such hypothetical scenarios, WILDSPACE DSS facilitates on-demand identification of real threats and environmental emergencies so that responses can be planned that are consistent with the needs of other species as well as with the requirements of other legislation. The culmination of data and information resulting from these spatial/temporal/taxonomic queries can support the user in making decisions.

References

Manly, B.F.J., L.L. McDonald, and D.L. Thomas. 1993. Resource selection by animals: statistical design and analysis for field studies. Chapman and Hall, London.

Wong, I.W., D.K. McNicol, P. Fong, D. Fillman, J. Neysmith, and R. Russell. 2003. The WILDSPACE™ decision support system. Environmental Modeling and Software **18**:521–530.