Lifemapper: Infrastructure and Web Services Enabling Biodiversity Research **[1]**

Submitted by astewart on Tue, 2013-07-02 02:10 **Event:** Summer Meeting 2013 [2]

Abstract:
Lifemapper, from the University of Kansas, is a multi-tier system containing an archive of species occurrence data and potential distribution maps, plus a set of biological research analysis tools. The research tools include two modules, Species Distribution Modeling, or LmSDM, for mapping the ecological niche of individual species and Range and Diversity, or LmRAD, for looking at the landscape level ecology of multiple species. These tools are built using web services and we provide a client for programmatic access or application plug-ins for connecting from QuantumGIS or VisTrails workflow tool. The backend of Lifemapper consists of compute, management, web, and data tiers. These tiers operate in a modular fashion; they may be directed to communicate with one or more instances of Lifemapper.

As a community resource, Lifemapper is committed to standard data formats and Internet access protocols and is increasingly focused on data transparency and repeatability through cataloging and documenting metadata and provenance. As part of the NASA-funded Earth, Life, and Semantic Web project (ELSEWeb), Lifemapper has extended metadata generation to enable the Semantic Automated Data Integration framework (SADI; http://sadiframework.org [3]) to orchestrate services between Earth Data Analysis Center (EDAC) and Lifemapper. This project automates the creation of Lifemapper Species Distribution models using MODIS data from EDAC web services as input climate layers, capturing provenance at each step of the process.

A related collaboration is with the Pacific Rim Applications and Middleware Assembly (PRAGMA). As part of the PRAGMA Virtual Biodiversity Expedition, a script running at Indiana University (IU) analyzed metadata at the Universiti Teknologi Malaysia (UTM) Geoportal instance to initiate Lifemapper SDM experiments using satellite and species data from Mount Kinabalu in Sabah, Malasia maintained at the University of Florida (UF). After Lifemapper completed the SDM models, the script retrieved and cataloged metadata in a GeoPortal instance running at IU. Next, we created a Lifemapper compute tier on a Virtual Cluster (VC) at San Diego Super Computer Center (SDSC). The VC requests jobs from and returns them to the KU Lifemapper management tier, where they are cataloged and stored. This VC primarily hosts and computes PRAGMA user data, permitting Lifemapper web services to be used with restricted-access data on permitted compute resources.

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Keywords: metadata [24]
macro-ecology [25]
biodiversity [26]
Standards [27]
Infrastructure [28]
Semantic Web [29]

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