LANDFIRE Data Product Applications

Title: *Modeling Alternative Scenarios of Land Cover Change and Conservation Outcomes in the Forest of the Northern Great Lakes Region Using LANDFIRE Data Products*
Date: 2012

Background:
The Forest Scenarios Project is an ongoing collaboration between scientists at the University of Wisconsin at Madison and The Nature Conservancy's Michigan, Wisconsin, and LANDFIRE programs. The project uses landscape modeling and scenario analysis to identify the potential outcomes for forested landscapes under various conservation strategies and climate change projections in two study areas—the Wild Rivers Legacy Forest (WRLF) area of northeastern Wisconsin and the Two-Hearted River Watershed (THR) of Michigan's Upper Peninsula. TNC and its many state, federal, and private partners are faced with the challenge of developing conservation strategies that span broad spatial scales, multiple ownerships, and a variety of ecosystems under changing socioeconomic and environmental conditions. This project was undertaken to facilitate planning of current and future forest conservation efforts by providing the ability to compare multiple conservation strategies and understand how their spatial arrangement influences conservation effectiveness.

Northern Great Lakes Region

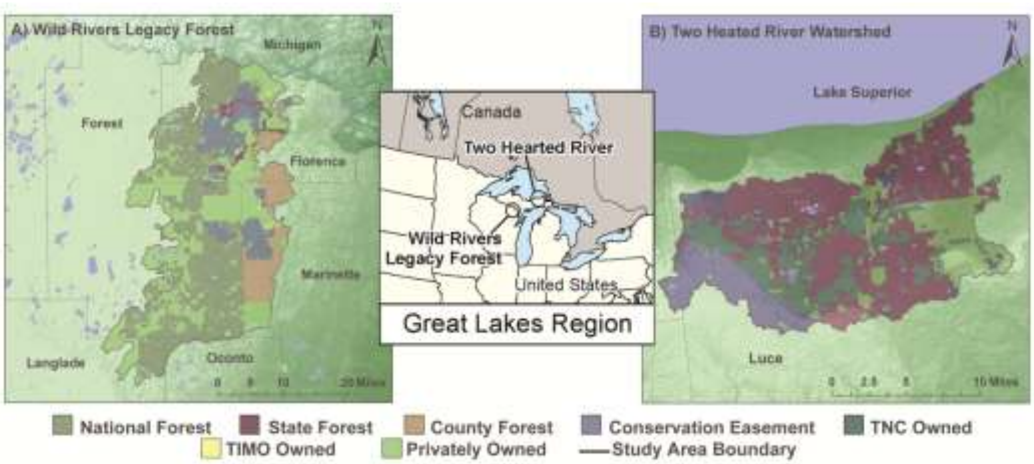

Figure 1: Maps showing the diverse ownership of each study area (USDA National Forest, State Forest, County Forest, Conservation Easement, The Nature Conservancy, Timber Investment Management Organizations and Private)

The Wild Rivers Legacy Forest (WRLF, figure 1 map A) study area spans 218,792 ha of northern hardwood and hemlock-hardwood forests, interspersed with a complex of lakes, cedar swamps and other wetlands, rivers, and streams. The Two Hearted River Watershed (THR, figure 1 map B) encompasses 53,653 ha and consists of upland hardwood forests, pine stands, and coniferous forests, interspersed with a variety of wetland systems, including muskeg, bogs, and swamps. In both study areas, diverse owners have multiple management objectives, exemplifying the complex mosaic of ownership and management that must be considered in landscape scale conservation efforts today.

Analysis:
Scenarios of alternative conservation strategies were developed with input from land managers, foresters, and conservation practitioners working in the study areas. Four conservation scenarios were developed (Price et al., 2012):

A. current management, B. no conservation action,
C. expanded easement, D. ecological forestry.

The scenarios were each modeled for current and climate change conditions.

For the THR watershed, current land cover was classified and mapped based on NatureServe's Ecological Systems classification scheme, the same scheme used by LANDFIRE. As a result, all land cover types appearing in the current land cover map were compatible with LANDFIRE Vegetation Dynamics Models. For the WRLF, the National LANDFIRE Biophysical Settings (BpS) and Succession Classes (S-class) layers were combined to generate a map of this study area that was compatible with LANDFIRE Vegetation Dynamics Models. These initial land cover maps contained cover type, seral stage, and structure information and provided the baseline from which alternative future landscapes diverge during the modeling process. Aspatial, state and transition models were developed in VDDT (Vegetation Dynamics Development Tool, ESSA Technologies) by modifying LANDFIRE Vegetation Dynamics models to reflect the probabilities of current natural disturbance and management in each land cover type for each scenario. VDDT models, the initial land cover maps, and other geospatial data, including ownership, served as an input for TELSA (Tool for Exploratory Landscape Analysis, ESSA Technologies), which was used to spatially simulate future landscape change under each scenario. Simulated future landscapes were assessed for their ability to support a suite of target species and ecosystem services using ArcGIS tools (ESRI, 2008). By defining parameters of habitat suitability, including spatial factors such as minimum core area, edge sensitivity, and dispersal distances, maps of primary habitat and corridors for each species were developed. Similarly, ecosystem services, such as timber availability, were mapped based on the characteristics of land cover and structure associated with each service.

Importance of LANDFIRE:
LANDFIRE data were critical for land cover change modeling in northern Great Lakes Forests. LANDFIRE map products and Vegetation Dynamics Models enabled simulation of ecosystem dynamics under current and scenario conditions in an efficient and cost effective way. LANDFIRE map products enabled spatial characterization of land cover and its structure without time-consuming, labor intensive, and expensive production of land cover maps specifically for this project. By providing a well-researched and expert validated starting point for modeling, LANDFIRE Vegetation Dynamics Models expedited the modeling process. The availability of nation-wide land cover maps and accompanying vegetation dynamics models means that the process developed for this project can be readily applied in other study areas around the nation. Together, these complementary products provide a powerful toolset for understanding ecosystem dynamics at broad scales.

Results:
We expect the results of this ongoing project to complement forest monitoring, inform adaptive management, and help sustain biodiversity and ecosystem services. Scenario analysis and landscape modeling enables TNC and UW-Madison scientists and conservation practitioners to better understand potential outcomes of complex and simultaneous interactions that influence landscape change over time, including ecological processes, climate change, and interactions of humans and the environment. For example, identifying the differences among simulated future landscapes to sustain biodiversity targets and provision of ecosystem services will enable land managers to better understand the potential impacts of climate change on the success of achieving specific management goals and identify the potential trade-offs between goals. Managers can make more informed decisions about how to use adaptive management to mitigate the impacts of climate change, to best utilize scarce financial resources, and to reduce the risks associated with the implementation of innovative strategies. These outcomes can also inform the processes of negotiating easement acquisitions, spatially arranging conservation strategies on the landscape, and maximizing return on investments.

Recommendations:
A current limitation of LANDFIRE data is the incompatibility of Existing Vegetation Type (EVT) layer with Vegetation Dynamics Models and ESSA's modeling tools. Spatially explicit modeling using these tools requires input of a current landscape map containing both cover type and seral stage information (S-class). While the EVT layer most closely represents the current landscape matrix, it does not contain S-class information. As a result, EVT and SCLASS layers must be manually joined by users and tediously crosschecked for accuracy and compatibility. Improved compatibility of the EVT layer with Vegetation Dynamics Models and ESSA modeling tools would further the use of these LANDFIRE products in simulating ecosystem dynamics into the future.

References:
Price, J., Silbernagel, J., Miller, N., Swaty, R., White, M., Nixon, K. 2012. Eliciting expert knowledge to inform landscape modeling of conservation scenarios. Ecological Modeling 229: 76– 87.

ESSA Technologies: http://essa.com/

ESRI (Environmental Systems Research Institute). 1998-2008. ArcGIS: Release 9.3 [software] Environmental Systems Research Institute, Redlands, California.

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